THE

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ELECTRICAL REVIEW.

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MOTOR PROBLEMS.

IN spite of the excellent progress that has been made in the design and construction of electric motors and controllers, there is much to be done before we can claim to be able to cope with all reasonable conditions of working. Not least of the difficulties that still await a complete solution is that of the variable-speed A.C. motor, and this question is constantly increasing in importance as the three-phase system comes more and more into vogue. It cannot be doubted that the future of electricity supply in this country—and, indeed, everywhere—is closely associated with polyphase currents; the proposition does not require demonstration—the facts speak for themselves. For constant-speed driving the induction motor, were it not for its heavy starting current under load and its deficiency as regards power factor, would be almost ideal; and, indeed, it is already so good that its improvement is not a matter of great urgency. But for variable-speed driving the problem is much further from an adequate solution. Granted that there are several extremely ingenious and highly efficient variable-speed A.C. motors on the market, we do not think it is claimed that any of these can successfully compare or compete with its D.C. rival without sacrificing one or other of the qualities of cheapness, efficiency, convenience, high power factor, constant-speed characteristic, or uniformity of speed variation. So long as the change of speed takes place by jumps, or, to avoid this drawback, a commutator is employed, the D.C. motor will retain material advantages for certain fields of application, and it is often considered preferable to convert part of the A.C. supply to D.C. rather than to install the A.C. machine. In saying this we do not wish to cast a slur upon the latter; we are merely stating facts that are well known to the practical men who are engaged in such work.

But, on the other hand, the D.C. motor is not faultless. Perhaps its most tender spot is its inevitable possession of a commutator. We have just pointed out its superiority over the A.C. motor for variable-speed work, but let us take the case of a D.C. shunt-wound machine with a combined controller and regulator, and having a speed range of 4 : 1. When this motor is running at its top speed on a 460-volt circuit, and an emergency arises requiring it to be stopped at once, the user throws back the controller handle, which action first cuts out the field regulating resistance, and if the machinery possesses considerable inertia, the motor will be driven by it for an appreciable period as a dynamo, generating at a pressure which may easily, under certain conditions, exceed 2,000 volts. Naturally, a flash-over is to be expected, but even if this does not happen, it is not fair to the motor to apply three or four times its normal voltage to the windings, perhaps many times a day. Moreover, the armature would be returning a heavy current to the mains at the moment when the circuit was opened, tending to burn the contacts of the starter.

Of course, a circuit-breaker can be used, but then up goes the cost; and some interlocking device is necessary to ensure the return of the controller handle to the starting position before the circuit is closed again, further adding to the cost and complication. Here is a nice little problem, which we commend to our inventive readers; it is not a hypothetical case, but an actual difficulty in present-day practice. Delaying-devices to prevent the quick throwing-off of the handle do not meet the requirements; a *quick* stop must be provided. And the solution must be mistake-proof, for the apparatus is handled by unskilled operators.

If the regulating rheostat is separate from the starting rheostat, it is not difficult to fulfil the desired conditions; apparatus is, in fact, available for the purpose. Our remarks apply only to the combined starter and regulator with a single operating handle, which from the practical point of view is desirable on the score of simplicity and cheapness—two considerations of the first importance.

The Skilled Labour Strike Ended.

Another most deplorable war-time dispute is ended, and the men have returned to their posts on the understanding that the Ministry of Munitions Committee of Inquiry will investigate immediately the matter of the embargo on skilled labour. The determination of the Government to withdraw protection certificates from men who remained on strike on Monday brought them to their senses. That the Government had behind it the support of the great body of the nation in its decision to deal with the matter firmly, is beyond all doubt. In critical days such as these, when our brave forces are in a position to deal more effectively with the Enemy "over there," and when in consequence a blow is being struck at the moral of the German people, it is impossible to tolerate traitorous conduct at the bench any more than in the trench. We deplore the existence of the spirit which permitted such a strike, yet we cannot altogether regret that the dispute has occurred, for it has revealed to the nation just where we stand in relation to certain industrial questions. We have cherished hopes of some measure of success attending the various efforts to secure Industrial Peace after the war, but these periodical strikes while we are at deadly grips with the tyrant foe do not encourage us in that connection. If men cannot submit to some limitation of their occupational liberties, while millions of others are risking their lives, in the interests of larger and permanent liberty, what will happen when there is Peace between nations? There is unquestionably a need for a strong Government with the nation behind it, and if a Parliamentary Election is going to secure such for us, the sooner it takes place, the better. If there is a loose rein after the war, or if there are blunders due to vacillation, the way to ruin will be short and steep. Sectional demands must never be permitted to imperil the interests of the nation as a whole.

Electric Traction and Freight Haulage.

In the minds of the public and the Government, the electric railway is associated only with the transportation of passengers. This is unfortunate, since it means that many miles of track are being used only for a fraction of their capacity, instead of fully sharing the burden of the great freight movement of the present time. An immediate step of the first importance in the relief of traffic congestion is the elimination of needless duplication of service of steam and electric lines. An article by Mr. A. B. Cole, who has recently made an extended personal study of the freight-carrying facilities of electric railways, in the *Electric Railway Journal*, dealing with seventeen typical cases taken from data secured from the War Board of the American Electric Railway Association, indicates the prevalence of this condition in the United States.

It has been said that steam railroads are best fitted for long hauls, but an investigation of the existing electric railways discloses some surprisingly long hauls, and shows what could be done by the addition of a few miles of track here and there, the increase of motive power and car equipment, terminal facilities, &c., to relieve the steam railroads of burdensome local passenger and freight service, particularly the latter.

Many interurban electric railways gave little or no attention to the movement of freight, especially those built during the early development of this class of transportation. Those constructed in more recent years have been devoting more attention to the development of this service. Fortunately, enough instances exist to prove that not only can electric railways do great things to relieve freight congestion, but also that they can do it in the fullest co-operation with the steam roads. Where there is duplication between steam and electric lines, the facilities of the latter should be used to their maximum capacity to relieve the steam line of the short-haul traffic. The general equipment, motive power, and cars which would thus be saved could be released for long-haul through freight and passenger service on the steam lines.

The undeveloped facilities of the electric railways that already exist are of such magnitude, and can be made available in the present crisis at such a comparatively small cost, that it would seem extravagant and wasteful were the Government to countenance any other means of transportation before the freight-carrying power of the electric roads had been fully developed.

The above observations apply mainly to conditions prevailing in the U.S.A., but they also apply in a less degree to this country. It is noticeable that while the electrified lines which already exist in this country cater for passenger traffic only, the goods traffic at night over the same railways is hauled entirely by steam locomotives. The reason for this inconsistency is not apparent, and we fail to see why such electrified railways as we already possess should not share in the haulage of goods as well as passenger traffic.

The amount of relief which the electric railways could afford the steam lines is not to be measured merely by the tonnage handled, but by the increase in the physical capacity of the steam railroads, through the elimination of long waiting at freight terminals, thus conserving fuel and labour by a reduction of standing time.

Trade with Italy.

The British Chamber of Commerce for Italy is working hard to increase its membership between now and September. It is justifiably eager that the coming of Peace shall find its organisation in a state of full efficiency, in readiness for encouraging and developing British-Italian reciprocal trade and economic relations in the future, and for preventing present enemies from resuming their former "overpowering position" in the Italian market. The membership of the Chamber which for 1917 was 845 has now grown to 950, and the present desire is to pass the 1,000 by September. The headquarters are at Genoa, while there are branches at Rome, Naples, Milan, and in Tuscany; one for Sicily is under consideration.

Many of our electrical firms are, no doubt, considering the needs of the Italian market and their own schemes, either individually or through associated action; but we have pleasure in drawing their attention to the work of the British Chamber which, as our pages have shown, has performed a very useful service almost from the beginning of the war in circulating information in this country concerning business opportunities in Italy that have been open to British manufacturers. The London offices are at Oxford Court, Cannon Street, E.C.

PRACTICAL POINTS CONCERNING INTERPOLES.

[COMMUNICATED.]

It is very convenient when testing interpole motors or dynamos to have some method of making the polarity of the interpoles right. Of course, if the machines are started up with the interpoles having the wrong polarity, sparking is sure to occur, and then the interpoles have to be altered.

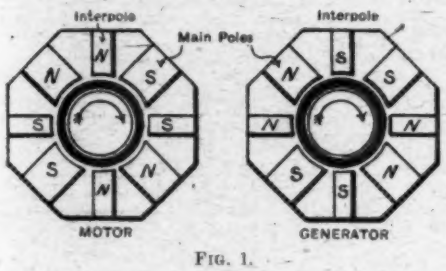


Fig. 1.

As the armature and interpoles are connected in series with each other, and a permanent connection is generally made of one armature lead to one end of the interpoles, it necessarily follows that if the interpoles are wrong the armature leads must be changed over, in order that the polarity of the interpoles with respect to the armature may be correct. When the interpoles are made correct in this manner, it is necessary to keep the armature and interpoles always connected permanently, and when it is necessary to reverse the direction of rotation, it must not be done by changing over the armature leads, but by reversing the shunt connections; if it is a shunt motor or dynamo, as a machine intended for a dynamo must be excited, it is run as a motor first, and the interpoles are made right in the same way; if it is a series-wound motor, the series field connection must be changed over. In the case of a compound-wound machine the series winding will also have to be changed over in order to keep it from opposing the shunt or weakening it. One of the best methods of finding out if the interpoles are correct has been found by the writer to be as follows:—

1. Move the brushes to the left or right of the neutral position.

2. Pass a current through the interpole coils and armature connected in series. The armature will then rotate

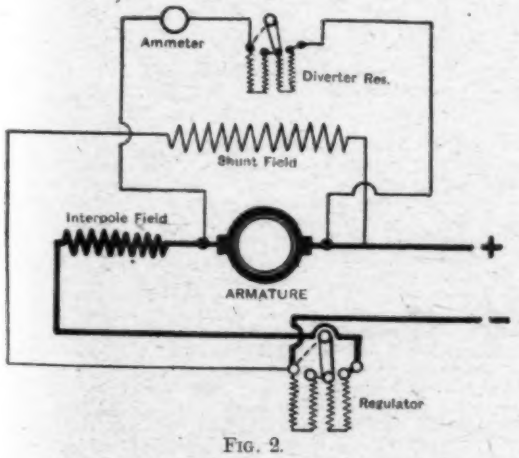


Fig. 2.

in one direction or the other when sufficient current is passing. If it rotates in the same direction as the brushes are moved, the interpoles are correct.

When it is found by the rotation of the armature that the interpoles are wrong, it is necessary to change over the two armature leads, or when it is not convenient, owing to the number of brush spindles, each armature lead should be moved to the next spindle of a different brush polarity.

If the interpoles are weak, it is possible for the armature to rotate in a direction contrary to the above rule, but this occurs very seldom, and would soon be discovered.

Another method is to start the machine up in the usual way and with load on. In most cases it would be improbable that much load could be got without severe sparking if the interpoles were wrong. If any doubt exists regarding the connections of the interpoles, it is possible to try round the yoke outside with a compass, but this is doubtful with a small load on the machine. If the inter-

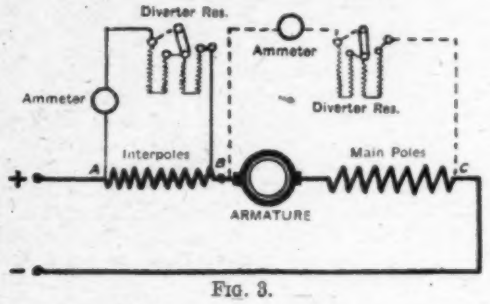


Fig. 3.

pole preceding a main pole with respect to the direction of rotation is of the same polarity, it is then correct in the case of motors, and otherwise for dynamos (see fig. 1).

There should be no sparking at all with interpole machines, and if the interpoles have correct polarity, and the machine is found to spark, there may be something wrong with the strength of them. If it is known what the resistance of the interpoles should be, the volts-drop can be taken when the machine is running, and if the resistance is low, it suggests that the interpoles are too weak. In the case of a shunt-wound motor, the current must then be diverted from the armature whilst the motor is running at full load, by means of a resistance connected in parallel with the armature, and having a regulating switch and suitable ammeter in circuit. The amperes should be diverted gradually, until the sparking ceases. This test is arranged as shown in fig. 2. Having got a sparkless position, the reading on the ammeter will then show how many more ampere-turns are required to be put on the interpole in order to make a permanent correction for sparking.

The interpole resistance being too high would suggest that too many ampere-turns were on the interpoles, and that they were too strong; this being the case, some current

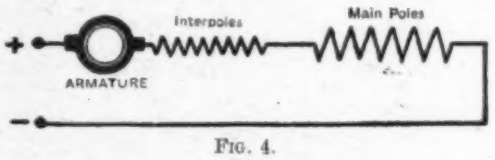


Fig. 4.

must be diverted from the interpoles, and a similar calculation from the ammeter reading, when sparking stops, will show how many ampere-turns require to be taken off the interpole coils.

When sparking takes place at all brushes equally, the fault will most probably be caused by the interpoles being either too weak or too strong, and measuring their actual resistance when the correct resistance is known will indicate in most cases whether they are strong or weak.

If the sparking took place at one set of brushes, and not at the others, this would show that one of the interpole coils was less effective than the others. To correct this, it would be necessary to take the resistance of each coil separately, when it would probably be found that some part of one coil was shorted. This fault may easily occur when copper-tape coils made up to carry large currents are placed in sections on top of each other without adequate insulation, or carelessly put together, and in some cases with ordinary wire coils also, the number of turns being incorrect. If one interpole were connected so as to have the wrong

polarity, it would cause worse sparking than a short circuit, as previously stated.

In temporarily strengthening or weakening the interpoles of a series motor when running, the connections should be made as in fig. 3, as, in the case of strengthening the interpoles, current would have to be diverted from *a* and *b*, and in the case of weakening the interpoles this arrangement allows convenient diversion from *b* to *c*. If the connections are made as in fig. 4, it is not convenient to divert current from the armature and series winding, leaving the interpoles only strengthened, therefore the connections in fig. 3 are best for the purpose.

Sparking may take place owing to bad design, such as too few sections in the commutator, which is a bad fault, but where the interpoles are faulty it can generally be remedied. If the interpole iron is too large in section, the tendency in most cases is for the motor to surge. By reducing the section, so that at a suitable load the density would become increased, surging may be prevented.

Surging takes place mostly on variable-speed machines which have the speed increased by weakening the main field. If the brush rocker is behind the neutral position with respect to the direction of rotation, the motor tends to surge, but by moving the rocker forward in the direction of rotation, the tendency to surge is reduced. The distance moved should be decided by the sparking and running conditions. Of course, the correct position of the brushes should be actually the neutral position, but in some cases it is necessary to keep the rocker slightly forward.

When the correct resistance of the interpoles is not known, and there is a doubt as to whether they are too strong or too weak, a very good method of finding out which is the case is given in an article in the Electrical Review, August 24th, 1917, by Frederik Murgatroyd, B.Sc., which uses the drop of volts between brush and commutator throughout the brush thickness. Test curves, made as explained in the article named, show exactly whether to strengthen or weaken the interpoles to cure sparking and to get ideal commutation.

If it is not desired to go to this trouble to get curves, it is practicable first to try weakening the interpoles, and if sparking increases try strengthening them.

PACKING MACHINERY FOR TRANSPORT.*

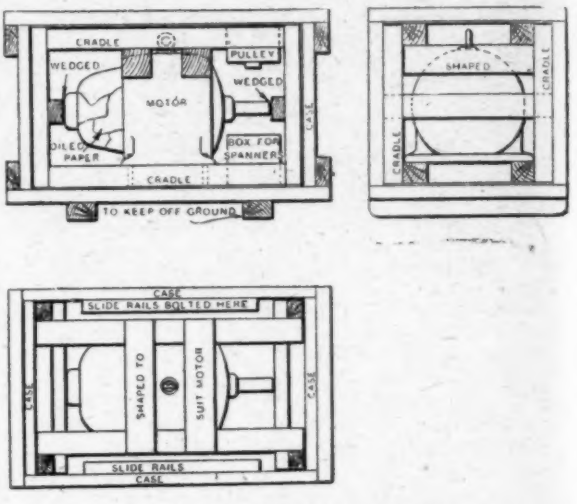
By J. F. SHIPLEY.

Both in Great Britain and still more in the United States packing is badly done. It should receive the attention of an engineer who has had experience at the receiving end. The usual method of first-class firms in this country is to build a case slightly larger than the piece of machinery to be packed. The machinery is then bolted down to one side and usually left unwedged. Auxiliaries such as tools, Lewis bolts, pulleys and rails are tied to the machine in a package by rope or string.

What happens to such a case during transit? It gets tumbled down on end; the machinery inside not being supported all round breaks away from the case and continues the journey loose. Every further tumble does more damage. The case arrives disabled, lugs and projecting pieces are knocked off the machine, paint is chipped, and dents occur everywhere. The new machine must at least go to the repair shop, involving loss of time, expense and exasperation to the customer. The manufacturer suffers a certain loss of credit, not much perhaps, because most manufacturers are alike. Often with, for example, an electric motor, the first tumble on the end allows the armature and shaft to move independently of the carcase. This results in the bending or shearing through of the oil rings, or of the detent screw of the bearing sleeves; or in either one or both end bearing shields being broken. Many machines so damaged have come to my notice.

The illustration shows a type of packing that has been proved as nearly perfect as possible. It costs about 30 per cent. more than ordinary packing. During 12 years about 10,000 such cases averaging 400 kg. per case came through my hands. The maximum expenditure in any one year for repair of damage to contents during transit was £20. The corresponding value of the goods was about £30,000. Insurance for breakage, usually costing 1 per cent. on declared values, is thereby unnecessary. Eight hundred such cases, containing hydroelectric machinery of all sorts complete with switchboards and instruments, were sent, with two transhipments and journey by rail, and then a 100 miles journey over mountain tracks by mule to the top of the Andes in South America. There were no breakages at all.

On the Pacific coast of South America, for instance, vessels at most ports have to lie out in open sea, and tranship their cargo into lighters for the port. The Pacific rollers are very heavy. The rise and fall of the lighter alongside of the ship is often 6 to 7 metres. If the crane operator does not gently drop the case of machinery when the lighter is at its topmost



Packing Case for Foreign Shipment.

position, a heavy fall occurs, the packing case may be smashed, and the machinery thereby damaged. Sometimes the goods go through the bottom of the lighter, and the lighter is lost as well. United States machinery suffers most under such circumstances.

Note that the material in the case is contained in and entirely supported by a strong but simple cradle. The cradle is entirely independent of but closely fits a strong packing case. Should the case be dropped on its end or in any position, the cradle will take the whole of the shock, transmitting it to the other end of the case, and it shields the contents from any injury at all.

In the event of such packing cases having to be stored, battens to keep the cases off the ground are bolted to the bottom, and the cases are lined, if not all round at least at the top and from a few inches down on each side, with tarred waterproof paper. Machines kept in storage for two years in a climate such as that of this country keep very satisfactorily.

* From the *American Machinist*.

A Skidding Test.—Some time ago the Bay State Railway, Boston, Mass., conducted a skidding test on Davis (American Steel Foundries) one-wear, cast-steel, manganese-tread wheels. It was desired to determine to what extent a skid of very unusual length would flatten these wheels, and to that end a stretch of level tangent track 110 ft. in length was prepared for the test, and was divided into three parts. The first section, 30 ft. in length, had both rails greased with heavy oil; the next 30-ft. section had both rails greased and sanded, and the remaining 50-ft. section had both rails covered with dry sand. The test was made with a 30-ton double-truck car with 33-in. wheels, and consisted in starting the car and attaining a speed of 35 M.P.H. at the moment of entering upon the 30-ft. greased section of track. An emergency application of the air brakes readily locked all eight wheels, and they were permitted to skid until the car came to rest, with the forward pair of wheels just clear of the farther end of the 50-ft. dry-sanded section. The forward pair of wheels skidded the full 80 ft., while the rear pair skidded some 25 ft. less. The wheels remained fixed, thus confining the entire abrasive action to the eight points of contact with the rails, which points were prick-punched for identification before moving the car. A careful visual examination of the wheel treads disclosed a brightly polished elliptical spot of about ⅜-in. major axis and ¼-in. minor axis. That the manganese treads are somewhat ductile was evidenced by the slight flowing of the steel to the trailing side of the contact ellipse, where it was deposited in a very thin ridge about $\frac{1}{64}$-in. in height. After the test was completed the test car was again put back on the line, and the wheels rendered satisfactory daily service for 15 months, at the end of which time they were removed as worn out.

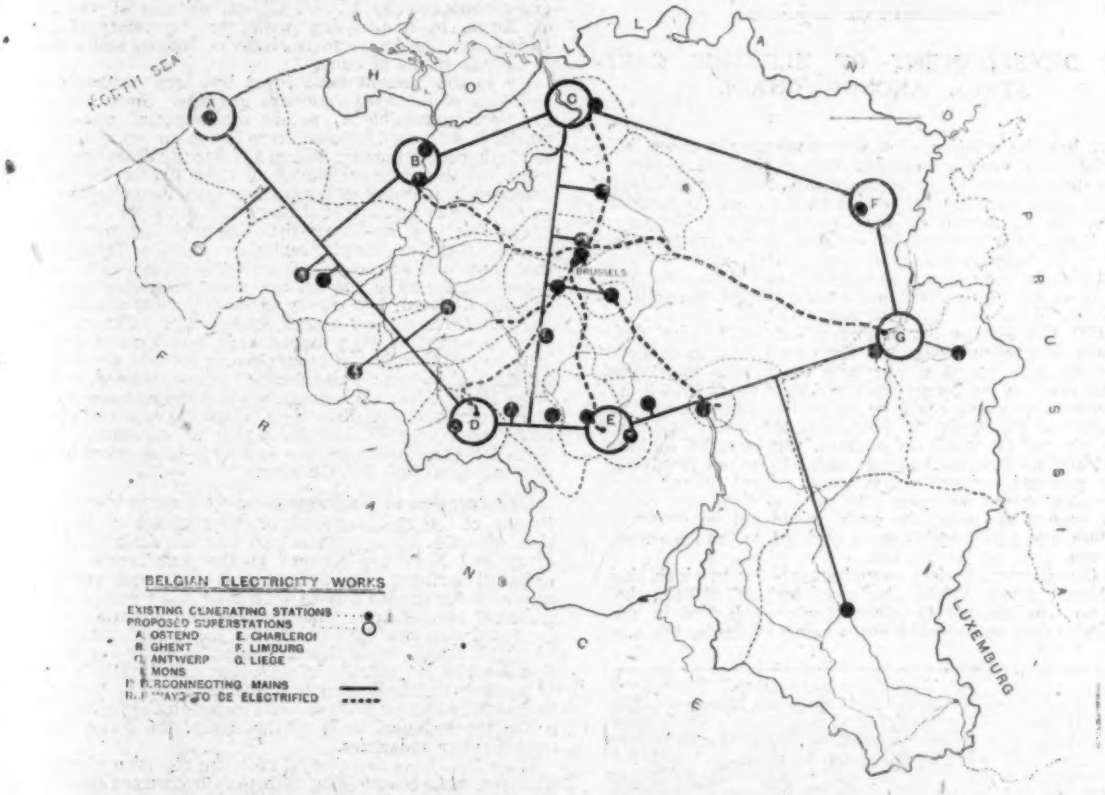
ELECTRICAL RECONSTRUCTION IN BELGIUM.

The Programme of the Comité d'Etudes pour la mise en commun des Productions d'Electricité en Belgique.

The "Committee of Investigation for the pooling of the production of electricity in Belgium" was constituted in London in January, 1917, after Mr. Joseph Carlier had proved by an extended study of the question, that it was imperatively necessary for the future welfare of Belgium after the war to pool the production of electricity. The committee is presided over by Mr. Maurice de Smet de Noeyer, chairman of the "Société des Docks, Force et Lumière," of Ghent. His secretary is Baron F. Chazal, Secretary of the Enquête Economique du Gouvernement Belge.

A report of all the work done up to July of this year is about to be published; but a most interesting report, over the signature of Mr. J. Carlier, vice-chairman of the "Comité d'Etudes pour la Mise en Commun," and Assistant Professor of Railways at Liége University, was placed before the London Committee of the "Enquête Economique" of the Belgian Government on February 8th last, which shows precisely on what lines electrical reconstruction in Belgium should proceed.

The accompanying map shows that as many as 26 important power stations were in existence in Belgium before the war. In addition to these, there were a good many small power stations, which need not be taken into consideration.



After the necessary developments in connection with the electrification of the railways and the reconstruction of the ruined industries of the country have been carried out, the generation of electricity should be concentrated at the ports of Ostend, Ghent and Antwerp, and at the coal pits of Mons, Charleroi, Liége, and Limburg.

Super power houses should be erected at these places, as indicated by the letters A, B, C, D, E, F, and G, and these should be linked together by mains at a pressure of something like 80,000 to 100,000 volts. The 26 existing stations would be supplied with energy in bulk by these super stations as shown on the map, which embodies the leading features of the J. Carlier system.

It will be of interest to consider some figures in connection with the scheme thus briefly outlined.

Mr. Carlier has calculated that if the railway network were completely electrified, the maximum demand for power would not exceed 250,000 kw. If all the industries were supplied with electrical energy for motive power, something like 500,000 kw. would be required. These figures are taken from official statistics.

Thus, on the whole, something like 1,000,000 kw. of power would be required, and if provision were made for the demand that would be experienced five to ten years hence, about 1,250,000 kw. ought to be provided for in the super station system.

Next let us consider the saving of coal that may be expected to result from the adoption of the scheme. During the year 1912 the Belgian collieries extracted 22,972,140 metric tons of coal, valued at 380,444,300 francs; the average selling price was 16 francs 58 per metric ton, and the average cost price 16 francs 22 per metric ton.

By the general electrification of the railways, a yearly saving of about 1,000,000 metric tons is quite possible; and by the application of electric power to industries, something like 3,900,000 metric tons can be saved. Roughly, therefore, 5,000,000 metric tons could be saved annually.

This represents, on the basis of the figures given above, a saving of 22 per cent. of the annual output of the Belgian collieries, having a value of about 83,000,000 francs. But that is not all, as a great many other factors of the utmost interest should result from the general electrification of the country.

To develop the use of electricity is, as we know from many instances, of great benefit to the wealth of a country. For example, in the United States the energy used per inhabitant is more than 56 per cent. over the figure for the United Kingdom, and we know that the town of Stalybridge (26,513 inhabitants) in 1915-1916 held the record in the United Kingdom for the use of electrical motive power, with the figure of 250 kw.-hours per year and per inhabitant. The more motive power is used, the greater is the earning power of any worker, say the people who are versed in social economics.

The solution of the worker's problem, and also that of the employer, is one and the same. It consists in the use of electrical energy for industrial purposes to the utmost possible extent.

Now, the Comité advocates the linking-up of the Belgian power stations which are still in existence, whilst keeping in view the construction of super power stations, so as to supply electrical energy in bulk to the 26 centres, which take the place of the old power stations.

From the document of January 18th, 1918, which was discussed at the sitting of the Belgian "Enquête Economique" in London of February 8th, we gather that the super power stations of about 100,000 kw. to 300,000 kw. should be erected at Ostend, Ghent, and Antwerp, and in the coal districts of Mons, Charleroi, Liége, and Limburg (Genck).

But as the gas coal exists for the most part in the districts to the south of Mons, and of Limburg (Genck), it seems likely that a very large system of big power stations should be erected to the south of Mons, since the conversion of the coal into gas is the most economical method of utilising the fuel.

Hence, the power stations at the ports of Ostend, Ghent,

and Antwerp should be of something like 60,000 to 80,000 or perhaps 100,000 KW. capacity, as they would be supplied with British gas coal for the most part, and the four coal districts should have power houses with outputs of 150,000 to 300,000 KW. or even more.

It must be borne in mind that this does not necessarily mean that only *one* big power house of 100,000 to 300,000 KW. should be erected in each of the industrial districts, but that many big power stations, using surplus heat from blast-furnaces and all kinds of plants, should be, as far as possible, linked up in the industrial area, so as to concentrate in the one system of the said industrial district all the supplies of electrical energy that are available.

How is an understanding to be arrived at between the actual power station owners, the industrials, the State, the railways, and the municipalities?

The only possibility appears to lie in the formation of a combine under a co-operative scheme, which should be called, for instance, the *Société Nationale d'Electricité*. In this company the large power consumers should participate as well as the producers of electricity, the State, and the municipalities.

In such a way the most effective co-operation between the industrials, the producers, and the public services should be attained, and the capital required to enable the Société Nationale d'Electricité to build the super-power stations, and to erect the mains for the delivery of the energy, should be subscribed by the consumers, who would be at the same time shareholders of the company.

Such an amalgamation of interests should practically give satisfaction to everyone concerned, and the combine of consumers and producers would in all probability lead to the best results with regard to the cheapening of electricity.

THE DEVELOPMENT OF ELECTRIC CAST-STEEL ANCHOR CHAIN.

RARELY has the solution of a war emergency problem been obtained with such promptness and unexpected success as in the development of an economical method for greatly increasing the production of stud link anchor chain, as described by Mr. W. L. Merrill in the *General Electric Review* of June, 1918. Any process for making chains which would make a real deduction in over-all labour had to be a radical change from the conventional hand-forging methods, particularly eliminating the preparation of the material for the chain, which the hand method required.

In 1911 the Marion Steam Shovel Co. built some chain, the links being 36 in. long, and the wire 7.5 in. in diameter, by casting one link at a time with the moulds interlocked. Samples made in the Schenectady Works of the G.E.C. proved that successful chain could be made by this process. The first attempt was made by die-casting the links, and afterwards placing the studs in position, the same as in hand-welded chain. This method was found to be not feasible for a large production since there is a very critical time at which the moulds should be opened to prevent shrinkage cracks, and if opened too soon, the metal would not be congealed. Therefore dry sand moulds were resorted to, and successful chain was made by this method.

The Classification Society's requirements for two-inch chain are: breaking test, 225,792 lb.; proof test, 161,280 lb., there being no requirements for elongation or reduction in area. No reliable data on wrought chain being available, the question of corrosion was dismissed, it being felt that the life of electric steel chain in comparison would at least last during the present emergency.

ELECTRIC CAST-STEEL CHAIN AFTER STUDS HAVE BEEN FITTED.

Comparative tests were made by subjecting single links to a blow under a drop hammer, which somewhat approximates the action of abnormal conditions to which practically all anchor chain failures are due. Neither the electric steel nor the wrought iron showed failure under this test, but the former showed less deformation than the latter. Further investigation was carried on, and processes worked up for moulding chain in sections complete with the studs cast as a part of the link, and successful chain was made by this process in several foundries. Then chain was made in various sizes from 1⅛ in. to 2¾ in., the former sized link apparently being the smallest that it is at present practicable to mould. Tests were then carried out with various samples of chain in comparison with hand-wrought chain and Navy chain from the Charlestown Navy Yard. These tests consisted of tensile tests and shock tests in a standard M.C.B. machine. In all cases the electric steel chain showed greater tensile strength and stood more punishment in the drop test than the wrought chain. Further tests were made to get comparative data and specifications on a shock bending test.

As a result of this work, the American Bureau of Shipping, and the American and English Lloyds have approved and issued specifications permitting the use of electric steel anchor chain on shipboard, these specifications differing mainly from those for wrought chain in the following points: The original breaking test of wrought chain is now specified for the proof test with proportional increase in tests for sample links above this of 40 per cent. For example, the original proof tests of 2 in. chain, 16,128 lb.; for electric steel, 225,972 lb. The original breaking test for wrought chain, 225,792 lb.; for cast steel, 316,109 lb. To this is added a shock bending test for sample links.

Electric Melting Furnace.—According to *Electric Traction*, the Bureau of Mines has announced the perfecting of a type of electric melting furnace that may be revolutionary in the making of brass. Patents on this furnace, known as the Rocking electric furnace, have been taken out by the Bureau and have been assigned to Secretary of the Interior Lane as trustee. Free licences to operate these furnaces under the patents, it is understood, can be obtained by making application through Van H. Manning, director of the Bureau of Mines.

The new furnace, which it is claimed will reduce the important losses in brass melting, is the result of five years' experimentation by H. W. Gillett, chemist of the Bureau of Mines, in co-operation with the laboratory of Cornell University, the American Institute of Metals, and a number of manufacturers of brass.

Up to the present most brass has been made in costly crucibles of imported clay and graphite. Since the war it has been impossible to obtain the imported materials for crucibles, and manufacturers have had to put up with crucibles of much poorer quality, and at a cost many times the pre-war price. With the huge tonnage of brass needed for war purposes, such as shells for cartridges, manufacturers have been anxious for a solution of the crucible problem. The Bureau states that it is inevitable that the next few years will see electric furnaces largely replacing crucible furnaces, and that there will be a development comparable to that seen in the steel industry in the last few years. The electric furnace, it is also declared, will greatly decrease the loss of zinc, which, together with copper, makes brass. Zinc boils at a much lower temperature than copper, and there have consequently been large losses in the open crucible furnace through volatilisation of the zinc. The electric furnace is closed, and these losses are avoided. It is estimated that the unnecessary losses in brass-making are more than $3,000,000 a year in normal times and perhaps $10,000,000 a year in war time. Another claim for the electric furnace is that it gives more healthful working conditions for the men.

Conservation of Engineers.—According to the *Electrical Review* of Chicago, engineers of every branch of the profession who are taking part in the war activities of the U.S. Army and Navy are alarmed at the unfortunate waste of technical training caused by the drafting and enlisting of engineers for regular service with little or no regard for their technical attainments. These technically educated and experienced men are essential to the successful conduct of the war and cannot be replaced. There is continuing evidence that America is repeating in some measure England's mistake of sending technical men into the ranks when they should be carefully conserved for special duties in the fighting forces or on the technical staffs of the Army, the Navy, and the essential war industries.

These facts have been forced upon the attention of engineers who have been co-operating with the Government through the Naval Consulting Board, the National Research Council and the Engineering Council. Upon these organisations requests have constantly been made for engineers, chemists and other technical men for a great variety of military services. Thousands of names have thus been furnished to the Government departments and bureaus. The Engineering Council especially has devoted attention to this personnel work through its committee, known as the American Engineering Service, which has available classified lists of approximately 25,000 engineers and besides unclassified lists of many more. It is from these lists, directly or indirectly, that most of the names have been selected for war service. Engineers do not seek to avoid fighting, but earnestly desire to be given opportunities for fighting and other services in which they can be most effective and which cannot be performed by others. In the opinion of the Engineering Council technically trained men of all ages should be enrolled and conserved for technical duties, and special efforts should be made immediately by the War and Navy Departments to find and record such men among drafted and enlisted forces, and to assign them to places in which their special qualifications are needed.

A later issue of our contemporary states that the Government has established a Division of Engineering to supervise the employment of technical men.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Austin Portable Electric Lighting Set.

In the *Advocate* for April (Vol. VII. No. 6), which is the house organ of the Austin Motor Co., Ltd., Longbridge Works, Northfield, Birmingham, there appears a description of their small portable petrol-electric set for lighting and X-ray work, the chief objects aimed at in the design being lightness, compactness, and reliability. The set comprises a single-cylinder petrol engine, giving 1¼ B.H.P. at a speed of about 1,300 revs. per minute, when using petrol as fuel, direct coupled to a reverse compound-wound charging dynamo having an output of 20 amps. at 35 volts. The engine is water cooled, being provided with a film-type fan-cooled radiator. A special drum-type controller is arranged to regulate the voltage from 4 to 35 volts, and the current according to requirements up to 20 amps. The engine and generator are mounted on a common aluminium base-plate supported on a wooden frame by means of which it can readily be transported.

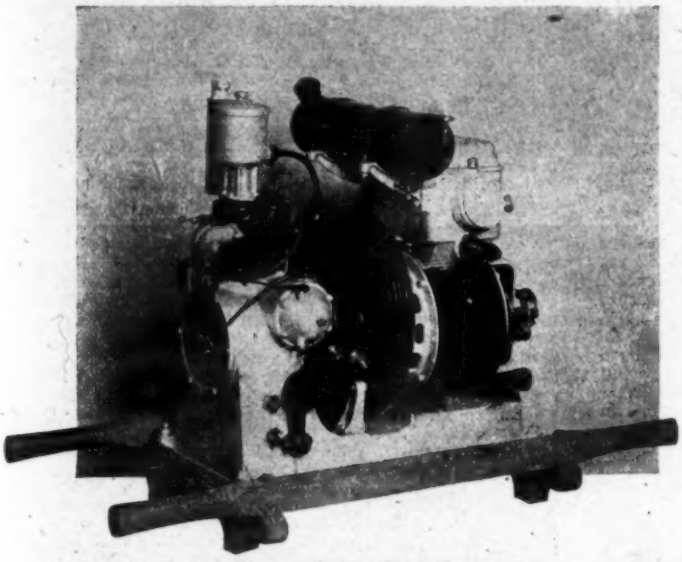


Fig. 1.—The Austin Miniature Portable Electric Lighting Set.

A Pilot Transformer Lamp.

A small transformer called the Ferrix pilot transformer is described in the *Revue Générale d'Electricité*; it is used in conjunction with a small low-voltage lamp, and takes the place of a current transformer and ammeter in connection with any A.C. circuit. When a current is flowing in the cable to which the device is attached, the lamp glows more or less brightly, according to the strength of the current, giving a rough idea as to the load on the circuit. For example, the instrument, which is very inexpensive, can be fixed on a cable supplying a motor, and will give warning when the machine is overloaded; in three-phase installations it shows approximately whether the phases are balanced, and in lighting circuits it indicates whether the lamps are in use or not. The primary absorbs only a fraction of a volt, the power consumption being from 1 to 5 watts, and in case of a short-circuit on the line the magnetic leakage of the transformer comes into play, and limits the secondary current, thus avoiding the destruction of the lamp.

Three Useful Terminals.

The terminals illustrated herewith can be made quite easily from odds and ends of workshop material and should be useful to electrical students and experimenters. Figs. 2 and 3 refer to terminals intended for connecting to wires quickly or when it is inconvenient to twist their ends together. In fig. 2, A is a piece of round brass rod of any convenient size that happens to be handy, with a hole B near each end. Sliding easily along the rod are two short brass collars C C, with flanges soldered to the ends that face one another, separated by a spiral spring D. After assembling the parts the ends of the rod should be spread slightly by hammering to prevent the tubes falling off. The ends of the wires to be joined are passed through the holes B B, while the flanged collars are pressed together. Upon releasing the latter they are pressed tightly against the wire by the tension of the spring.

A simpler arrangement directed to the same end is shown in fig. 3. Two washers A A, of stout brass are dropped over a short brass bolt B, with a spiral spring C, between them. Screwing on the nut completes the terminal and keeps all the parts together. The wires to be joined are looped round the ends of the bolt and held by the pressure exerted by the spring.

The terminal shown in fig. 4 is intended for gripping very thick wires, and while of no use to the electrical instrument maker, is often handy for general experimental work. In addition to joining two thick wires a thinner one can be connected simultaneously, as a shunt. Two strips of thick sheet brass, ¾ in. wide, are bent twice at right angles as shown at A A, and soldered to a straight piece of the same material, B. Holes are made exactly opposite one another at C C, and D D, about $\frac{1}{16}$ in. in diameter or a little less. The thick wires to be connected are passed through these holes, and gripped by the spring studs E E, taken from an old electric lampholder. A thinner wire can be connected if desired by looping the end round the small brass bolt, and screwing down the nut.—H. J. Gray.

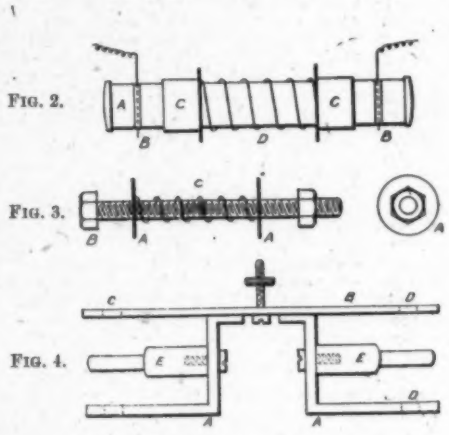


Fig. 2.

Fig. 3.

Fig. 4.

Figs. 2, 3, and 4.—Useful Terminals.

A New Electric Tractor.

The Couple Gear Freight Wheel Co., of Grand Rapids, Mich., U.S.A., which has for some years been making a four-wheel electric motor tractor, has recently introduced a new model—a three-wheel tractor, designed for the purpose of converting ordinary types of horse-drawn wagons into motor vehicles, by simply substituting the tractor for the horses. As will be seen from the accompanying illustration, fig. 5, the new machine has a single-driving wheel of an improved type, mounted on springs at the front, the feature being that the armatures of the motors are mounted on ball bearings, while in addition Timken roller bearings are provided to carry the load and to take the thrust, enabling the end thrust bearing formerly used to be dispensed with. The outside diameter of the wheel band has also been reduced in order to permit the use of standard sizes of tyres; the new wheel is rivetless, the discs being cast from steel. The clearance within the wheel has been increased materially over that provided for in previous models, and the motors are designed for a maximum pressure of 250 volts, and to give ordinary speeds at a pressure of 88 volts. The current is provided by a battery, mounted in a special cradle under the frame between the wheels, and the controller is located at the left of the driver's seat. The flexible cable connecting the battery to the motors in the driving wheel is pivotted to the centre of a guard placed longitudinally over the driving wheel tyre. It is claimed that the tractor is approximately no longer than the length of the horses it displaces, and that it and the wagon to which it is attached can be turned in the same radius as a horse-drawn wagon.

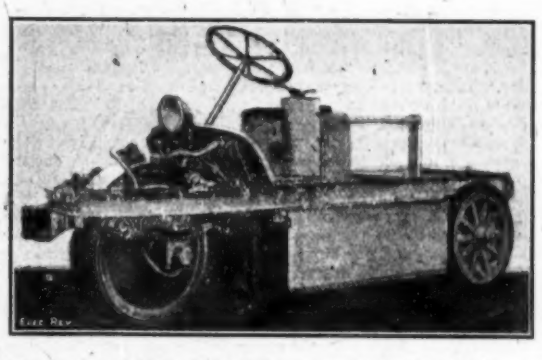


Fig. 5.—A Couple Gear Three-wheel Electric Tractor.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electric Propulsion of Ships.

I note Mr. Stanley Cook's reply to my remarks concerning Mr. Eskil Berg's claim for extremely high propulsive efficiency, and I really do not see what more I can add; pending Mr. Berg's own reply, which will surely come, there may be some reason for this higher efficiency of which I am not aware of, but I do know that on the *Jupiter* the American Navy officers carried out some very scientific tests before deciding on the electrical propulsion of their larger and more powerful vessels.

It is true that I said that it is not "economically" possible to provide a very high gear ratio in the "mechanical geared" method in this transmission, and my experience guides me; but, I am surprised that Mr. Cook makes claim to only 1 per cent. loss in such, in single gear, and 2 per cent. in double train. I can assure him that if he has been successful in bringing about such small losses which will stand up to the test of time under full duty, that he has done more than all the other gear makers I have approached, not only in this country but also in many parts of the Continent of Europe. He, however, is wrong in his statement that the induction motors in my "Paragon" system control the speed reduction in each case, because of large diameter; he will be interested to note that recent experiments which I have made in my laboratory have proved that future cargo boats will be fitted with, say, steam turbines running at 3,000 R.P.M. and propellers driven at full power at 100 R.P.M., and this without the use of gearing in either the case of the turbine or the motor. This 30 to 1 reduction in speed is made possible in the new "Paragon" variable speed short-circuited polyphase alternating-current motor, and I may add that a continuous range of speed can be obtained (without steps) from zero to full revolutions, with full torque. At the same time, I have cut down switchgear to the very minimum, consisting of the simplest and most robust nature. Transmission efficiency, as Mr. Cook is well aware, is not the only thing to be considered in connection with the design of the propulsion plant of large ships; there are many other features of engineering operation to be considered, and in all cases which I have struck, the electrical ship shows up best, and that is the opinion also of the finest brains in the United States Navy.

I realise also that there are few gentlemen in this country who have had more practical experience of "geared turbine" driven ships than Mr. Cook, and it would indeed be in the interest of the nation if the Government were to allow us to fit two sister ships—he to fit his ship with his 1 per cent. gears and I to fit my ship with my latest inventions; let these two ships steam side by side, carrying exactly the same naval equipment as regards guns and armour. Let them proceed at "full power" for 60 hours, and then at "cruising speed" for a further 100 hours, and then return to port and weigh the amount of fuel left, after taking the same amount aboard when starting. Personally, I have no fear which ship would be the more efficient. As I said before, it is not the maximum transmission efficiency that matters; there are other things besides, and I am certain that Mr. Cook can give a very shrewd guess what they are.

William P. Durtnall.

London, S.W., *July 28th*, 1918.

Heating and Cooking by Electricity.

Our attention has been called to your leading article on heating and cooking by electricity in your issue of July 12th. Upon inquiry, we find a typed letter was sent to a few of our Irish clients from our Dublin office, and this letter was referred to in the *Irish Builder* of June 22nd.

The appearance in a Dublin paper of the figures relative to the fuel required to generate electricity led to our pointing out the loss of heat due to conversion of coal into electrical heat.

The letter was the outcome of a proposition which had been made to heat a large assembly hall by electric radiators. Upon investigation as to the capital outlay and running costs of heating the hall by electricity, gas, and hot water respectively, it was finally decided to adopt a hot-water apparatus, this being the most economical.

The question of cooking by electricity had not arisen, and, therefore, cooking should not have been mentioned in the letter in connection with the heating problem.

We are entirely in agreement with Mr. H. C. Hopkin's remarks on electric cooking, in the same leading article—viz., that when intelligently managed, it is highly efficient for the reasons he named, but for the heating of water in quantity it is more economical to use steam where the latter is available.

G. N. Haden & Sons.

Trowbridge, *July 26th*, 1918.

Trade Unions; Past, Present, and Future.

If there is really a movement towards forming a new Trade Union, will you please forward my name as one who is eager to become a member? There is no time like the present, when so many who have been non-unionists all their lives, on principle, are wondering if they are doing the best thing by standing outside.

The present Unions are so over-run by the weeds of politics and ignorance that it is useless to hope for reforms by the entrance of new members.

Amongst the recommendations of the Whitley Report was the suggestion that all labour should be organised. But how can any man with a spark of patriotism and of average intelligence attach himself to any of the present Labour organisations?

What is wanted is a movement which aims at lifting, as well as helping, the *British* working man. Some of the present Labour movements seem to be out to assist the alien against the British, especially should he be of the enemy variety. We want to wipe out the slur now hanging on that word *worker*, so suggestive just now of shirker.

A fair day's pay for a fair day's work should be the new call, instead of as much as possible for as little as possible.

A Labour movement on broad common-sense lines would attract not only non-union, but also all the best of the union members.

Electrical Fitter.

July 21st, 1918.

Instruments for Central-station Switchboards.

In this controversy Mr. Fawssett has the advantage over me in so far that he writes with full knowledge of the results of the tests he made, whereas I only know that portion of them which he chooses to disclose. To illustrate my meaning, I need only point to the reference in my previous letter regarding accuracy under varying pressures; this was quite a random shot, and has drawn the interesting information that the "Aron" meter wins in this respect.

It is true that Mr. Fawssett's figures show the motor meter, though a bad second, to have no great error when the pressure is reduced by 10 per cent; but why does he say nothing as to the effect of increasing the pressure by a similar amount? This is another random shot!

Apart from this, I am afraid Mr. Fawssett's attitude in this matter has not been altogether above suspicion. After refusing to let me have his complete results because, forsooth, our competitors objected, he sent to them that portion purporting to show the "Aron" meter in an unfavourable light, without waiting for our permission. At the time I did not question his attitude, because I understood the results were to be treated as being private and confidential; but when the letter from the "A.M.I.E.E." appeared in your journal, I again asked for the complete results, with no further success.

Clearly "a very complete and careful series of tests" must have comprised very much more than has been disclosed, and I, for one, would like to know how the competing meters behaved on starting current, low loads, and overloads, and on short-circuits. What was the effect of stray fields (a point upon which Mr. Fawssett laid great stress in his original specification); and were the motor meters tested for hysteresis errors?

I think I have written enough to show that it is absurd for Mr. Fawssett to ask your readers to judge the merits of the competing types from the one or two results he chooses to pick out from his series of tests. After all, the best criterion in a question of this kind is the test of experience under practical working conditions, and it was presumably the result of this test which prompted Mr. Fawssett to write that he "quite expected it (the Aron meter) to beat the other."

Mr. Fawssett states that I was to send along to him our latest pattern shunted meter; but, as he informed us that he would not change while the war was on, *even if he got satisfactory results*, I could not be expected to set aside Class A war work to make up meters for him.

Aron Electricity Meter, Ltd.
(F. A. NIELD.)

London, N.W., *July 29th*, 1918.

Women in Central Stations.

I have read "E. H. H.'s" letter in the "Correspondence" columns of the current issue of the REVIEW, and I sincerely hope that the opinions expressed therein are not those of the majority of station engineers and managers in this country.

Whilst undoubtedly great difficulties have had to be faced by engineers and managers since the outbreak of hostilities, still one cannot help thinking that "E. H. H." (from the tone of his letter) is one of those individuals who cannot (or will not) patriotically adapt themselves to the changed circumstances of the times, even after four years of the greatest war in history.

Referring to the question of the employment of women in electrical stations, perhaps "E. H. H." is not aware that as far back as the summer of 1915, women switchboard attendants were employed on all the shifts in a large and important municipal generating station with E.H.T. three-phase and also D.C. plant, and although they had to be trained for the duties on the job itself and had no previous training, they did wonderfully well, and patriotically carried on in the absence of the men.

Further on in his letter "E. H. H." says:—"No one objects to give a man who has served his country in the Army or Navy, especially if he has been one of those in uniform who actually fight the enemy or the elements, a chance," &c., &c. "E. H. H.", perhaps, requires gently reminding of the fact that if it were not for the courage and self-sacrifice of thousands of his fellow men, he might not be sitting securely in his presumably pre-war berth (and grousing, too, at the circumstances!) at the present moment.

One is proud to think, however, that hundreds of electrical station engineers nobly responded to the call of their King and Country, and have done splenid work in H.M. Forces, and among

the lists of those on service will be found the names of not a few chief engineers and managers too.

Possibly a good many of those engineers who have made such sacrifices will never be quite so fit again for their former duties, and the least that those at home can do to help the men who fought for them, is to see that they obtain suitable positions once again, and that their former berths are not retained by the men who have secured promotion through their more patriotic brother's absence on naval or military service. It is to be hoped that the E.P.E. Association will see that the latter point, at least, is not overlooked.

Turning to the question of the training of ex-service men for positions such as switchboard attendants, &c., if "E. H. H." had had experience in both home and colonial generating stations, he would know that "a good general and technical education and three years' training" is not nowadays considered an essential preliminary, and the writer has seen native boys of 15 or 16 years of age, with no previous training, and unable even to speak English, trained in a few months as switchboard attendants in a H.T.-A.C. station of 1,000 KW. capacity! The employment of women and also ex-service men in an increasing ratio in electrical stations is very probable, and, perhaps, by the cessation of hostilities, even "E. H. H." will have modified his somewhat conservative and unpatriotic attitude!

July 28th, 1918. **Staff-Sergeant R.E. (T.)**

LEGAL.

ISAACS *v.* HOBHOUSE.

(*Concluded from page* 82.)

ON Wednesday, last week, Sir Henry Norman gave evidence, and corroborated that of Sir Chas. Hobhouse. He denied that he had invited von Lepel to form an English company or promised to procure for him financial assistance; neither had he told the Telefunken Co. that they could rely on Government support. Mr. Reginald McKenna was next called, and gave evidence with regard to the decision of the Cabinet to withdraw the repudiation of the Marconi contract. Sir John Simon then addressed the jury for the defendant. He said it was impossible to reconcile the two stories; "one of the two people here is a liar." During his address Mr. Hird was recalled, as a matter of urgency, and stated that he had discovered a letter dated July 21st, 1914, from the same directors of the Telefunken Co., who had written to Mr. Isaacs. The letter said that von Lepel would probably endeavour to make a start in England, with the support of Sir H. Norman, and asked Mr. Hird to communicate with the Marconi Co. with a view to opposing the attempt to start a new company. There was no reference to Sir Chas. Hobhouse or the Imperial Wireless Chain.

Sir John Simon then concluded his address to the jury, and the hearing was adjourned. On the following day Mr. Leslie Scott, K.C., took occasion to complain of his Lordship's references to the forgery of documents, remarking that it had been apparent that he was taking a strong view in favour of the defendant.

MR. JUSTICE DARLING said, in summing up, that the letters complained of, which did constitute an actionable libel, were the culmination of a long dispute between Sir Chas. Hobhouse and Mr. Isaacs, or the Government and Mr. Isaacs. It was said that it was a dishonest, wicked invention that the defendant had palmed off on the House of Commons, and that the memorandum prepared in order that he might make the speech was a false document. His Lordship, referring to the letter of the Telefunken director, asked the jury which they believed—Von Bredow and Solff, or Sir Chas. Hobhouse and Sir Henry Norman, and whether they believed Mr. Isaacs's denial that there were two letters. The jury, he said, had to look at the case broadly, and decide whether the document prepared on the night of February 5th, 1915, was a forged document.

The jury, after deliberating for over an hour, returned a verdict for the defendant.

Judgment was accordingly entered, with costs, which his Lordship, on the application of Mr. Leslie Scott, agreed should be taxed and paid over on the usual undertaking in the event of a successful appeal.

A.E.G. ELECTRIC CO., LTD.

IN the Chancery Division, Mr. Justice Younger had again before him the petition of the Board of Trade to wind up this company under the Trading with the Enemy (Amendment) Act, 1916.

MR. AUSTEN-CARTMELL, for the Board of Trade, said the petition had been standing over to see what progress was made with the case before the Official Receiver in connection with the arbitration with the Rio Tinto Co., in which there was a large claim and counter-claim. That matter was not yet completed, and the company took the view that it might be embarrassed in those proceedings if a winding-up order were made at this stage. The Board had no desire to embarrass the company in connection with the arbitration proceedings, and was willing that this motion stand over until after the Long Vacation.

MR. CONWAY, for the company, said his clients felt that they might be prejudiced in the other matter if an order to wind up the company were made at this stage.

His LORDSHIP said the petition could stand over until the first petition day of next sittings, but should anything occur to make it desirable, the Board of Trade could renew its application for an order during the Long Vacation. His Lordship added that it might be necessary to have some sittings of that Court during the Vacation.

WAR ITEMS.

The Imperial War Conference and Demobilisation.—The Imperial War Conference held on July 22nd discussed at the instance of the Government of Canada various problems respecting demobilisation, particularly connected with transportation. Ultimately, on the suggestion of the War Office representatives, a resolution was passed agreeing that an advisory and executive committee, to be known as the Military Demobilisation Committee of the British Empire, should be set up forthwith. This committee will consist of representatives of the military authorities, Dominions and Colonies, and representatives of the War Office, India Office, and Ministry of Shipping of the United Kingdom, under the chairmanship of the Secretary for War or a deputy appointed by him. The committee will consider all military questions of demobilisation affecting the various Governments concerned; will arrange for the fullest interchange of information regarding plans for demobilisation; and will submit questions of principle arising from time to time to the Governments concerned. The committee will sit prior to general demobilisation, at such times as the chairman may consider necessary, and during demobilisation as frequently as may be necessary to secure complete co-ordination of the demobilisation procedure of the Governments concerned.

Trading with the Enemy.—The *London Gazette* for July 26th contains further lists of persons or bodies in the following countries with whom trading is prohibited:—Argentina, Paraguay and Uruguay; Brazil; Chile; Costa Rica; Cuba; Ecuador; Guatemala; Netherlands; Netherlands East Indies; Panama; Peru; Spain; and Sweden.

Exemption Applications.—Before the West Kent Appeal Court, exemption was sought by C. F. Mounsdon (34, Grade 1), electrical engineer, of the Sundridge Electrical Works, Sevenoaks. It was asked that time should be given until August 31 to allow another man to take his place. The appeal was dismissed, with 42 days grace.

At Southampton, the Corporation Tramway Department applied for exemption for eleven employés. Three months were allowed, the volunteer condition being waived.

The Malvern Tribunal granted temporary exemption until December 28th to C. H. Clemens (36, Grade 2), electrician, with Messrs. Sparkes & Houlton.

At Rochdale, on the recommendation of the Advisory Committee, exemption until November 30th was granted to T. Kenworthy (31, Grade 3), electrician, appealed for by Messrs. Kelsall & Kemp, Ltd.

At St. Albans, Messrs. Nicholsons, Ltd., appealed for the retention of J. W. Allen (45, Grade 2), electrical fitter, in charge of the motor and lighting plant. Three months were conceded with a view to substitution.

At Canterbury, there was a review of the case of A. Johnson (27, Grade 2), electrician, with Messrs. Court Bros. The conditional exemption was cancelled, and two months' substituted.

At Oxford, the Electric Tramways Co. appealed for D. Campbell (38, Grade 2), traffic superintendent, and three months' temporary exemption, without the volunteer condition, was granted.

At Ryde, there was a review of the case of H. F. Jolliffe (28, Grade 1), wireman and joiner with the Isle of Wight Electrical Co. The manager (Mr. Braithwaite) claimed that he was in a certified occupation, and the National Service Representative (Mr. Colenutt) said that left it open for the Tribunal to say whether the man should be in the Army or not. Mr. Braithwaite contended that Jolliffe was doing work of national importance. If a breakdown occurred he was the only man they had to do the repairs. Mr. Colenutt submitted that an older man should be found to do the work, and he would consent to an adjournment to see what could be done. Mr. Braithwaite said that the Order stated that a young man was not to be prejudiced if in a certified occupation; they could not get old men for this work. The Tribunal cancelled conditional exemption, and substituted three months, the mayor saying that they hoped that in the meantime a substitute would be found.

Electric Baking Ovens.—Bread can be baked electrically by much lower expenditure of heat than is needed in steam-heated ovens. Cases are cited (*Elektrotechnik und Maschinenbau*) in which, other factors being as nearly as possible identical, steam ovens used 0·19 to 0·21 kg. of coal per kg. of bread (*i.e.*, 955 to 1,060 calories), whilst electric ovens used 0·39 to 0·42 KW.-hour per kg. of bread (*i.e.*, 322 to 359 calories). The power consumption of the electric ovens was 90 KW. and 50 KW. respectively. During a short test the energy consumed for the initial heating is a large proportion of the whole energy consumption. The average consumption of the 50-KW. electric bake oven, excluding the consumption for initial heating, is about 0·35 per KW.-hour per kg. of bread. Indirect electric heating with heat accumulation is not inferior to the direct system with heating elements in the oven. In both cases the average consumption is 0·35 KW.-hour (300 calories) per kg. of bread, as compared with 0·2 kg. of coal (1,000 calories) per kg. of bread baked in steam ovens.

REVIEWS.

Engineering Mathematics. By C. P. Steinmetz. Third Edition, revised and enlarged. London: Hill Publishing Co. Pp. xix + 321. Price 12s. 6d. net.

This volume is not a text-book on mathematics, but is designed to fill a rather special and definite gap which is often found to exist in the mathematical equipment of an electrical engineer. There are, for instance, many men who possess a fair knowledge of the phenomena of electrical engineering on the one hand, and of the ordinary branches of mathematics on the other hand, but who lack familiarity with the somewhat specialised methods of mathematical statement and calculation which would enable them to obtain the full advantage from their knowledge in both directions when it comes to the point of carrying out actual concrete calculations and obtaining practical results. In short, they have not learnt the most appropriate methods of dealing with the special and peculiar problems which arise in connection with the various types of electrical engineering problems. It is just here that Dr. Steinmetz offers his help in this book, which is mainly directed towards illustrating the methods by which electrical problems may best be handled in mathematical terms. It is to the electrical engineer that the author chiefly makes his appeal—and in a special degree to the student of his own works on alternating-current phenomena, &c.—though he has also included a number of problems drawn from other branches of engineering, notably those arising in connection with the problems of the steam turbine.

As already stated, it is not one of the aims of the book to be a text-book of mathematics, and, indeed, we can well imagine the ordinary teacher of mathematics (or, perhaps, we should have said, the teacher of ordinary mathematics) holding up his hands in righteous protest against some of the unorthodox methods adopted in it, and lamenting, not without some measure of justification, what appear to be wilful evasions of strict mathematical reasoning.

For the electrical engineer who has had a good grounding in the usual elements of a mathematical course, and whose main object is to use his knowledge of mathematics as a tool, and as a means to an end, rather than as an end in itself, for such a man, this book should prove most suggestive and inspiring, and of real value when he is confronted with some of the more complex calculations arising in his work.

Coming to a more detailed examination of the contents of the book, the first chapter is devoted to the subject of the general number, which includes the algebra of the complex number containing real and imaginary elements. We are here introduced to the rules for the addition, subtraction, multiplication, and division of complex numbers expressed in both rectangular and polar co-ordinates. It is by means of simple examples or illustrations, rather than by mathematical proofs, that the author proceeds from one step to another. His tacit assumption that symbols and conclusions may be applied indiscriminately, and without any apparent distinction to positions of points, the definition of finite lines, vectors, pure numbers, and even physical quantities, such as currents and voltages, is at times rather bewildering, and may sometimes prove to be a stumbling block to the student until he has made further progress and has become more familiar with the writer's methods. As an example of the author's lack of precision in these matters, we may refer to page 30, where we read: "The distance of the point which represents the general number A from the co-ordinate centre is called the *absolute value*, radius, or scalar of the general number or complex quantity. It is the vector a in the polar representation of the general number: $A = a (\cos \theta + j \sin \theta)$." The inexperienced student, who has been taught to distinguish carefully between a scalar and a vector, may be excused if he protests that this sentence leaves him in doubt as to the category to which he should assign the symbol a. This example is, however, a matter of verbal ambiguity, rather than a lack of clearness in expression of ideas. It is in connection with the representation of the vector quantities of current and voltage, and the scalar quantities of impedance and admittance a few pages later that the reviewer regards the failure to draw a clear distinction between the characteristics of these quantities as being a serious omission, and a probable cause of a good deal of obscurity to the student.

Another distinction which the reviewer thinks should have been drawn, and which is entirely overlooked by the author, is that which exists between the dual *rôle* played by the symbol j ($\sqrt{-1}$). Sometimes j represents what the author calls the "quadrature unit," *i.e.*, it represents "unit vector in quadrature with the main vector axis." In other connections, j is an operator, and has the effect of producing a rotation of a vector through 90 deg. when that vector is multiplied by j. If this distinction had been clearly drawn, it would have been easy to indicate the essential difference between multiplying a current $I = i_1 + j i_2$ by a voltage $E = e_1 + j e_2$, in which j is a unit quadrature vector, and multiplying the current by an impedance $Z = r + j x$, where j is an operator producing rotation of the original vector.

Chapter II is a useful discussion of the use of expansion into series, and of exponential functions in respect of their utility for the practical purposes of engineering calculation. It includes a very clear treatment of the application of differential equations to the numerical solution of problems, with examples designed to show in what cases they may be made to give the required solution.

Chapter III is entitled "Trigonometric Series." The first part of this chapter forms a summary of the usual formulæ, giving the relations between the ordinary trigonometric functions. The second part is of special interest and importance, since it deals with the composition of curves representing both periodic and transient phenomena. We have here a most instructive and helpful treatment of the subject of the curves, which mean so much to the electrical engineer. Dr. Steinmetz is specially helpful in connection with this subject, because he approaches it with such a wide experience gained by dealing with these curves from a practical point of view, and with the purpose of gaining definite information from them. His discussion is consequently in marked contrast to that usually found in mathematical treatises, while his mastery of the mathematical aspects of the subjects enables him to adopt many simplifications with confidence. Typical curves of various kinds are given, and the evaluation of their various harmonic components is illustrated in full detail. After working carefully through this section, the student should find himself well equipped for analysing or interpreting any form of curve which may arise in his experimental work.

Chapter IV is another extremely interesting and practical one; it deals with the maxima and minima of functions. It consists mainly of a wide selection of engineering problems in which some variable quantity is plotted as a curve, and its maximum or minimum value is ascertained graphically or by differentiation. Incidentally, many interesting points are brought out, both on the practical engineering side and in connection with the mathematical handling of the problems.

The next chapter deals with methods of approximation, and is also illustrated by some practical problems in electrical engineering, though it is necessarily more mathematical than the preceding one, dealing, as it does, very largely with the expansion of expressions into series.

The last two chapters, dealing respectively with empirical curves and numerical calculations, contain many valuable aids in plotting the results of observations, and in subsequently classifying or analysing them by mathematical methods. As examples of the curves discussed, we may mention core-loss curves, hysteresis curves, alternator voltage curves, volt-ampere characteristic of the tungsten lamp, &c. The choice of scales for plotting, the use of logarithmic paper, the proper tabulation and checking of results, are some of the practical points included, and are dealt with in a way which is clear proof of the author's wide experience and careful attention to detail.

It would take too long to enumerate all the useful mathematical devices which the author has included in this book, and we must conclude this rather cursory survey by saying that it is the work of an eminent electrical engineer who has employed mathematics as a tool in his own practice, and has here set down valuable hints gained in the course of his experience for the assistance of his younger colleagues. For a book of this kind—unconventional and, possibly, incomplete as a mathematical guide though it may be—we owe Dr. Steinmetz a debt of gratitude.

Electrical Measurements. By Frank A. Laws, S.B. London: Hill Publishing Co., Ltd. Pp. xiii + 719. Price 21s. net.

This is a well printed and well got-up book of over 700 pages by the Professor of Electrical Engineering, Massachusetts Institute of Technology, and Harvard University. It is intended as a general treatment of the subject of electrical measurements, but particularly it is written to be of service rather to the student of electrical science engaged in the laboratory or the testing shop than to the full-fledged engineer, though, for the matter of that, there is much within its pages which the latter will find useful. As it is primarily designed for the student, the fundamental processes with regard to electrical measurements have been treated in detail, and it is assumed that users of the book have had courses in physics, the theory of electricity, and in mathematics such as are given to third-year students in technical schools of the first rank. With regard to laboratory work, the author makes the useful suggestion that interest and discussion are stimulated if such work is so arranged that the various members of the class while engaged upon the same general topic carry out the experimental work by alternative methods.

The work is divided into 15 chapters, and at the end there are a couple of pages on the legal definition of the electrical units in the United States. The first 13 chapters deal with such subjects as the measurement of current, the ballistic galvanometer, resistance devices, measurement of resistance, potential difference and electromotive force, power measurement, inductance and capacity, induction instruments, electricity meters, phase meters, power-factor indicators, synchroscopes and frequency meters, instrument transformers, the calibration of instruments, &c.

Chapter XIV, on the determination of wave form, is very good, and is plentifully supplied with diagrams and photographs of apparatus. The final chapter is on cable-testing, and contains much interesting and instructive matter.

At the end of each chapter there are references to certain

important papers connected with the subject matter, so that the specialist may obtain a more detailed discussion of the various methods. The figures and diagrams, of which there are nearly 450, are well drawn, and very clearly and accurately reproduced.

The Theory of Electricity. By G. H. Livens, M.A. Cambridge: University Press. Pp. vi + 717. Price 30s. net.

This is a volume of some 700 pages. There is little in it that appeals to the practical man, and it will probably be found of service only to those who have the time and inclination to delve into the more abstruse parts of electrical science. But regarded with the eyes of the theorist, it is really a monumental work, being an attempt to present a general text-book on the mathematical aspects of modern electrical theory.

The method of treatment adopted by the author is chiefly based on the original Faraday-Maxwell theory, generalised and extended to the case of moving systems by Sir Joseph Larmor; for he holds that this form of the theory, in spite of being abandoned in recent accounts of the subject, remains the only one which appears to be completely satisfactory from the point of view of mathematical and physical consistency.

The book opens with a general mathematical introduction. Then follows the main treatment, which is divided into two parts, (1) statics and kinetics, and (2) dynamics. The former includes the consideration of the production and characteristic properties of the electric field, the electrical and mechanical relations of a system of conductors, the Faraday-Maxwell theory of electrostatic action, the theory of polarised media, magnetostatics, electric currents in metallic conductors, and electric currents in liquid and gaseous conductors; the latter includes the electromagnetic field and some special electromagnetic fields, electrodynamics of linear currents, electromagnetic oscillations and waves, and the electrodynamics of moving media.

At the end there is an appendix containing 339 questions to be solved by the student, and an index of names.

Electricity Meters. Second Edition. By C. H. W. Gerhardi, A.M.I.E.E. Pp. xx + 504. London: Benn Bros., Ltd. Price 15s. net.

The small number of books dealing with the subject of electricity meters and their testing and maintenance has more than once been remarked, and, in view of the importance of this subject, this circumstance is not a little curious. The appearance of the second edition of Mr. Gerhardi's work will, therefore, be particularly welcome to engineers in charge of central-station test rooms. In preparing the new edition of the book the author has not only brought it up to date by the addition of descriptions of the latest types of meters, European and American, now on the market, but has also rectified a noteworthy defect of the earlier work by adding an entirely new chapter on the measurement of polyphase power and the testing of polyphase meters. Included in the work are descriptions of all types of meters in common use in this country, notwithstanding many of such types being superseded by more modern designs, and being no longer manufactured.

The chapter on polyphase meters above-mentioned deals briefly with the theory of the measurement of three-phase power. The author rightly deprecates the use of a single meter for so-called balanced three-phase circuits, and strongly urges the use of more scientific methods if anything like accuracy is required. Diagrams of connections for these meters are, however, included, as this method is still sometimes used. The author prefers the single polyphase meter to the use of two single-phase meters for the measurement of energy in polyphase circuits. His objections to the latter method do not seem very forcible; the contingency of a negative reading on one meter is not a very likely one, and by the use of two meters a rough mutual check is obtained. The author recommends the adjustment of polyphase meters to secure independence of phase rotation. This seems rather a counsel of perfection. The descriptions of polyphase meters are accompanied by diagrams of internal connections of the meters.

The second part of the book deals with the testing and repair of electricity meters, and with the arrangement and equipment of testing departments. The author's description of his own test rooms is interesting, but the work would have been more valuable if some suggestions for the equipment of test rooms for small stations had been embodied. In many such works it is exceedingly difficult to obtain even the barest necessities, and many of the refinements and conveniences described by the author are utterly out of the question. One or two suggested schemes on very simple and elementary lines would therefore doubtless have been specially welcome to test-room superintendents in the smaller undertakings.

In the chapter on instruments and apparatus, useful descriptions of the Kelvin balance, the Drysdale double wattmeter, and the potentiometer are given, together with an explanation of the degree of accuracy requisite in the various instruments in use. The author lays considerable stress on the provision of a standard of time. This seems, however, hardly on the same footing as the provision of accurate watt, ampere, and volt standards, in that time indicating instruments can so frequently and easily be checked. The errors of stop-watch readings, moreover, are almost entirely composed of personal errors of stopping and starting, and jump errors when the centre-seconds train is thrown into gear, the errors of calibration of the watch being remarkably small as a rule. When it is remembered that a watch losing five minutes per week has an error of 1 in 2,000, or about 0.05 per cent., the necessity for a standard chronometer in any but the largest and most important test rooms is not apparent. The notes on adjustable resistances, choking coils, secondary cells, and other apparatus will be found more useful.

A chapter on meter-testing follows. The author appears to favour the adjustment of the speed of the meter to suit the counter train rather than the reverse process of adjusting the train by means of a change-wheel to suit the observed speed, and urges as an objection to the latter method the necessity of a dial test. The dial test is, however, one that should always be taken, particularly after the meter has been taken down for repair. The use of a change-wheel is specially convenient, in that it enables the required adjustment to be made with certainty. The description of the testing of polyphase meters is excellent, and the diagrams of connections are most valuable. Diagrams are given for testing both on single-phase and three-phase circuits, and these diagrams will doubtless be found exceedingly useful to those who, by reason of their having to test these meters but infrequently, are not quite as well acquainted with the subject as they might be.

The chapter on meter testing *in situ* includes a description of portable testing meters. There are chapters on meter fixing, meter reading, and meter repairs, together with a suggested system of meter records. This system will probably be found altogether too elaborate for any but the larger undertakings, and one or two alternative schemes on a much smaller scale would have been very useful. There is a table of meters approved by the Board of Trade, and a complete index. A further table collecting the information given earlier in the book regarding the shunt losses, full-load torque, testing constants, and other data would have been very desirable. The book, in its present form, is a most valuable and complete work, covering the most up-to-date practice, and dealing with every branch of the subject of electricity meters. It can be thoroughly recommended to all engineers who are concerned with or interested in this subject.—G. W. S.

BUSINESS NOTES.

Italian Cable Manufacturers' Association.—*Il Sole* (Milan) announces the formation, on July 3rd, of an Association of Manufacturers of Rubber, Cables, Electric Conductors, &c., between 14 Italian firms, which employ about 20,000 workpeople, and have an output of goods valued at several hundred millions of lire per annum. (Lira = 9½d. at par.) The President of the Association is Senator G. B. Pirelli, and the Vice-Presidents Comm. Ing. V. Tedeschi, of the S. A. Ing. B. Tedeschi, of Turin, and Ing. Romola Pola, of the Societa Piedmontese Industria Gomma e Affini, of Moncalieri. The object of the Association is the development of the rubber and electric conductor industries in Italy by the study of all questions affecting their expansion in Italy and abroad.—*Board of Trade Journal.*

Patents and Alien Enemies.—Applications have been made to the Board of Trade by Messrs. J. Musgrave & Son (1913), Ltd., Messrs. Daniel Adamson & Co., Ltd., and Messrs. Willans and Robinson, Ltd., to avoid or suspend nine patents granted to Müller for steam condensing plant.

Book Notices.—"Magnetic Measurements and Experiments." By A. Risden Palmer. Pp. 124; 24 figs. London: T. Murby & Co. Price 1s. 6d. net.

"Electrical Experiments." By A. R. Palmer. Pages xii + 115; 49 figs. London: Thomas Murby & Co. Price 1s. 6d. net.

"Selwyn's Metric Conversion Tables." By W. E. Dommett. Pp. 49. London: James Selwyn & Co., Ltd. Price 2s. 6d. net.

"A Bibliography of Municipal Utility Regulation and Municipal Ownership." By Don Lorenzo Stevens. Pp. vi + 410. London: Oxford University Press. Price 17s. net.

"Additions to the Formulas for the Calculation of Mutual and Self-Inductance." By F. W. Grover. (Scientific Papers of the Bureau of Standards, No. 320). Washington: Government Printing Office. Price 10 cents.—This paper furnishes a list of formulæ for the calculation of mutual and self-inductance which have appeared since the publication of the earlier paper dealing with the same subject (Scientific Paper, 169). Some of the formulæ here given, notably those for eccentrically-placed circles, provide solutions for cases where none has been previously available. Copies may be obtained from the Bureau.

"*The B.E.A.M.A. Journal.*" July, 1918. London: King's House, Kingsway, W.C. 1s. net.

Liquidations.—British Autogenous Welding Co., Ltd.—Meeting August 30th, at 268, South Lambeth Road, London, S.W. 8, to hear an account of the winding up from the liquidator, Mr. L. M. Fox.

Holidays.—The office and works of The Crypto Electrical Co., Ltd., Willesden, will be closed from Saturday, August 3rd, until Monday morning, August 12th.

The works of the New Switchgear Construction Co., Sutton, will be closed from Saturday, August 3rd, until Monday, August 12th.

The works of Messrs. Connolly Bros., Ltd., Blackley, will be closed from to-night until Monday, August 12th.

Catalogues and Lists.—Messrs. Jenson & Nicholson, Ltd., Goswell Works, Stratford, London, E. 15.—Sixteen-page pamphlet giving particulars of their varnishes, japans, enamels and paints to meet engineering and industrial requirements.

Messrs. Boilerine, Ltd., 885A, Old Kent Road, London, S.E. 15.—Circular respecting their radiator tablets for prevention of rust, corrosion or deposits.

Non-Ferrous Metal Industry Act.—The *London Gazette* for July 30th contains a further list of licences granted under this Act.

Electric Vehicles at Chester.—Referring to the satisfactory results obtained from the working of the electric vehicles used by the Corporation for refuse collection, which we recently recorded, we understand that the handling of this equipment throughout, and the financing on a deferred payment system, were carried out by the vehicle department of Messrs. Drake & Gorham, Ltd., who are sole agents for Edison Accumulators, Ltd., in the district.

Canadian Electrical Inquiry.—The High Commissioner for Canada (19, Victoria Street, S.W. 1) has received an inquiry from a Canadian electrical firm which wishes to enter into negotiations, for post-war trade, with United Kingdom importers of brass and porcelain sockets, cut-out receptacles, rosettes, attachment plugs, current taps, tumbler and snap switches, shade-holders, lampholders, and door bolts.—*Board of Trade Journal.*

Cast-iron Pipes.—The Stanton Ironworks Co., Ltd., Nottingham, have sent us a neat momento of their c.-i. pipes in the form of a glass desk tray.

LIGHTING AND POWER NOTES.

Bath.—Year's Working.—The accounts of the Corporation electricity undertaking for the past year show a profit of £593, compared with a deficit of £1,782 in the previous year. The gross income was £31,031, against £26,507, and the expenditure was £17,638, against £14,987. Capital charges amounted to £12,186.

Birkdale.—Price Increase.—The Electric Supply Co. has increased its charges as follows:—Lighting, 5d. per unit., plus 20 per cent.; power, heating, and cooking, 1½d., plus 20 per cent. The minimum charge will be 7s. 6d. per quarter.

Bolton.—Year's Working.—According to the annual accounts of the Corporation electricity department for the year ended March 31st last, the revenue amounted to £109,230, compared with £91,140 in 1917, and the working expenses to £61,938, against £48,157. Of the gross profit of £47,292, interest, income-tax, and depreciation absorbed £40,387, and, after meeting other charges, there was a surplus of £3,375, against £2,708 in the previous year. The works cost per unit was '417d., against '374d., and the total cost amounted to '513d., against '479d.; 24,654,804 units were sold during the year, against 20,616,535, including lighting, 1,580,770, against 1,523085; tramways, 4,740,802, against 4,576,352; and power, 16,864,944, against 13,493,857.

Braintree.—Prov. Order.—As the Crittall Manufacturing Co. has notified its intention to apply for an Electric Lighting Prov. Order, the U.D.C. has instructed the E.L. Committee to renew the Council's application.

Brighton.—Year's Working.—There was a surplus of £2,887 on the past year's working of the Corporation electricity department, against £5,140 in the preceding year. The total income amounted to £119,003, compared with £109,059, and the expenditure to £76,026, against £61,994. Capital charges absorbed £40,140, against £42,060. The works cost per unit was 1·4d., against 1·15d., and the total cost, including loan charges, was 2·66d., against 2·5d. Units sold numbered 10,242,007, against 9,771,615.

Bristol.—Year's Working.—According to the annual accounts of the Corporation electricity department, the revenue for the year ended March 31st last amounted to £177,339, and the expenditure to £105,351. After deducting interest (£20,596), loan redemption (£32,330), and other items, £5,156 was carried forward. Units sold during the year numbered 26,839,580, compared with 23,579,139 in the previous year. The works cost per unit was '752d., against '813d., and the total cost was '920d., against '989d. Coal consumption per unit was reduced by 18 per cent.

Burnley.—Wages.—The employés at the Corporation electricity works have refused the 25s. weekly bonus offered to them, and the matter will be the subject of arbitration by the Committee on Production. The War Wages Committee has recommended that 25s. per week bonus be paid to the men engaged on ramway relaying work.

Carlisle.—Year's Working.—There was a net profit of £1,295 on the past year's working of the Corporation electricity undertaking, against a deficit of £196 in the previous year. The revenue amounted to £34,987, against £27,287, and the expenditure to £23,171, against £17,384. Interest and redemption charges absorbed £10,520. The units sold totalled 5,879,532 (compared with 4,750,591), including power and public lighting, 5,092,916; private lighting 532,142, and traction, 256,000. Works costs amounted to '56d. per unit, against '5d., and the total cost per unit to 1·37d., against 1·39d.

China.—Recent Extensions in Power Plant.—The normal growth of Canton as a leading centre, and its prospects for the future, have led the Kwangtung Electric Supply Co. to decide to increase the capacity of its plant. A contract was signed recently for the purchase of two American high-pressure non-condensing turbo-alternators, rated at 2,500 kw., three-phase, 60 cycles, 2,300 volts; one American high-pressure non-condensing turbo-generator, 350 kw., 125 volts, direct current; switchboards, pumps and other accessories. The contract also calls for four 750-h.p. Babcock and Wilcox boilers. The extension of the plant under this contract will be made with the object not only of supplying the city and its environs more extensively with light, but also of furnishing electric power for the various industries that have developed during the past few years. When the additional machinery and supplies are installed, the Canton plant will be the largest in China, except that at Shanghai.

In addition to Canton, electric power plants have been installed in many other cities and towns of that Province and of the neighbouring Province of Kwangsi. The present enhanced price of kerosene is greatly adding to the number of electric light patrons, and ensures good prospects for these ventures. The electrical equipment of the installations was purchased for the most part in the United States, while the engines came from England.

The subject of future power development in all parts of China is a question of vital interest to the future growth of the Republic. Native coal fields are known to exist in many sections of China, but the prolific water powers of the great interior possess such untold possibilities for future development, that other sources of power generation fade into insignificance in comparison.—*Journal of Electricity.*

Clogheen (Co. Tipperary).—Fire.—The electric lighting plant installed for the supply to the town has been destroyed by fire.

Continental.—Spain.—Application has been made by a Vigo syndicate for a concession to utilise the water power of the River Alberchi, near El Tiemble, for the generation of electricity.

Cork.—Lease Renewal.—A Special Committee of the Corporation has secured a reduction in the number of years to be embraced in the new lease sought by the Cork Electric Tramways and Lighting Co., with an appeal to the B. of T., should reasonable provision not be made as regards the extent of supply and price of electricity, or at any time the Corporation should be of opinion that the charges of the company are unreasonable. A clause has also been included to the effect that, in the event of the company at any time failing to give a reasonable service of tramway-cars on the existing routes, the Corporation shall be at liberty to take over the undertaking on six months' notice, on terms of purchase set forth in the deed of transfer.

Croydon.—Year's Working.—The accounts of the Corporation electricity department show a deficiency for the year ended March 31st last of £2,651, though there was a net increase of income of £11,411. The deficiency has been carried forward, and the charges for electricity increased by a further 25 per cent., making a total war increase of 75 per cent. It was explained, at a meeting of the Corporation, that coal alone would cost a further £5,500, so that there was a deficiency for the present year of £9,000 or £10,000 to be made good, which the increased charges would just about meet.

Edinburgh.—Price Increase.—The E.I. Committee recommends that the charge for electricity for lighting be raised from 3½d. to 3¾d. per unit, and for power from 1½d., plus 25 per cent., to 1¾d., plus 25 per cent.

Erith.—Bulk Supply.—The U.D.C. has given a Sub-Committee full powers to conclude negotiations with the West Kent Electric Co. for a supply of electricity in bulk to the Council, and also to Vickers, Ltd. A loan for the materials and apparatus needed is to be applied for.

Glasgow.—Year's Working.—The accounts of the Corporation electricity department for the year ending May 31st show a revenue of £789,002, an increase of £208,568 over the previous year, while the working costs were £542,717, an increase of £138,312. Depreciation amounted to £60,134, and capital charges to £179,005, leaving a net profit of £7,145. The electrical engineer states that the price of energy to all consumers will have to be increased by not less than ¼d. per unit.

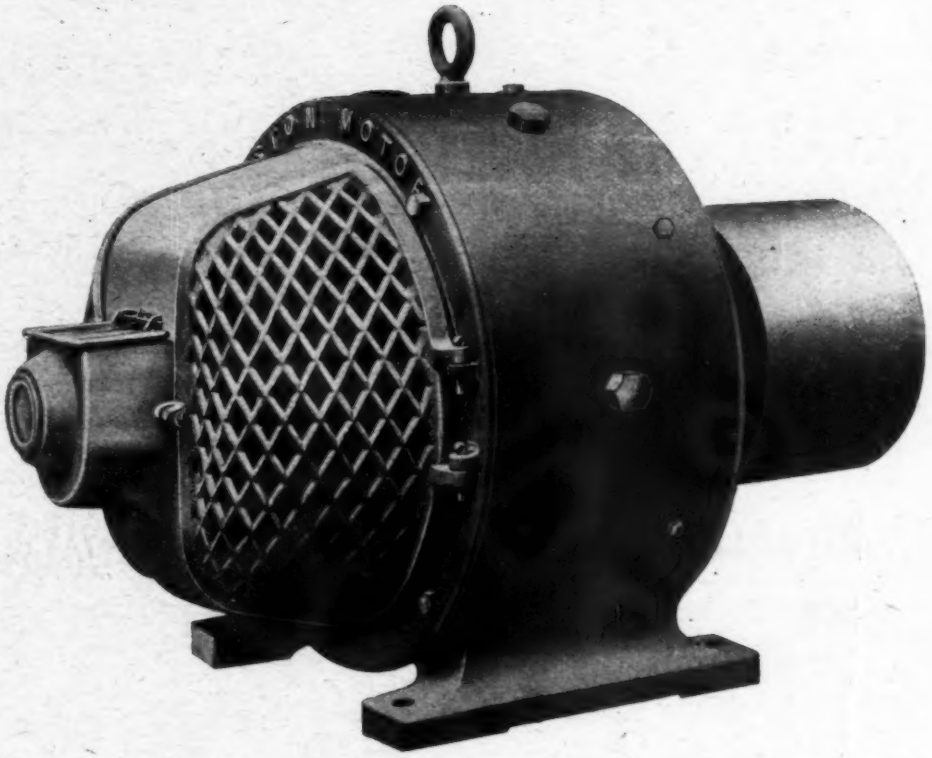
Halifax.—Price Increase.—Subject to the approval of the T.C., the charges for electricity are to be further advanced by 12½ per cent. all round.

Hastings.—Year's Working.—The accounts of the Corporation electricity department for the year ended March 31st last, show that the income was £20,941, an increase of £1,854 compared with the preceding year. The expenditure was £14,404, compared with £13,056. Interest and sinking fund charges amounted to £11,114, compared with £11,126. An adverse balance of £4,628 transferred from the net revenue account was met out

VERITYS LTD

ENGINEERS,

WORKS: ASTON, BIRMINGHAM.



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$\frac{1}{6}$TH B.H.P TO 200 B.P.H.

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M. 119

LAURENCE, SCOTT & CO., LTD.

Estab. 1884. **NORWICH.**

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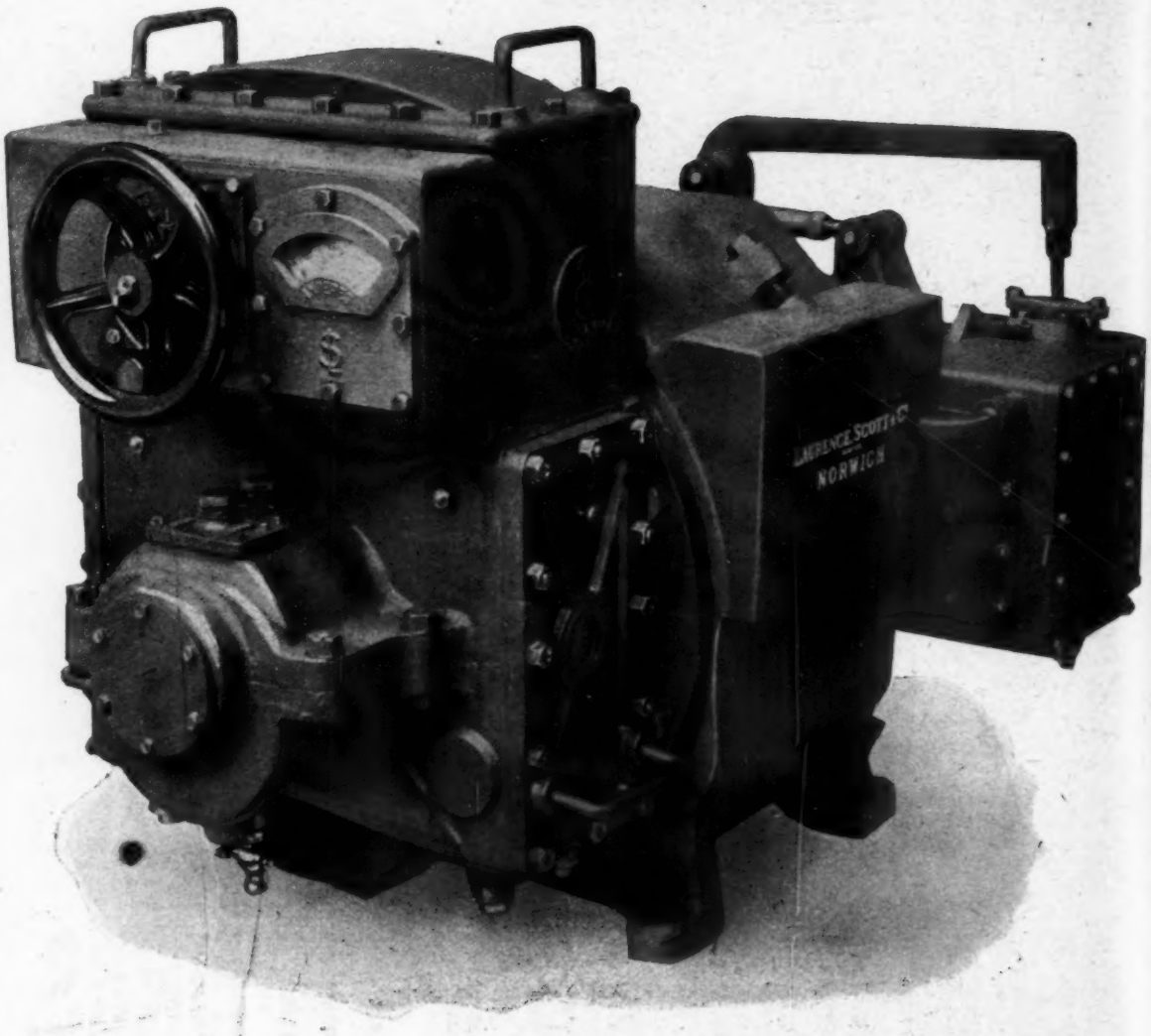

SPECIAL MOTORS & CONTROL GEAR

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SHIP WINCHES.

"BANQUO" SYSTEM (Registered).

AS SUPPLIED IN LARGE NUMBERS TO ARSENALS, DOCKYARDS, EXPLOSIVES WORKS, CHEMICAL WORKS, FACTORIES, ETC.

SINGLE POLE 5-AMP. SWITCH.

"BANQUO" IRON-CLAD DISTRIBUTION SWITCH SYSTEM.

Supplied Single or Double-Pole.

This System will commend itself to engineers as an improvement on the practice of mounting a number of switches inside the same box as the fuseboard and in place of straggling single units. The switches are mounted on one iron base, this being usually fitted in proximity to the distributing fuse-box. The switches are foolproof, and saving is effected in cost and labour. The words "ON" and "OFF" are cast on the lid, and the switch handle is of cast gun-metal, giving a substantial yet neat appearance. The boxes can be drilled & screwed to requirements, and there is ample space inside cases for safety and ease in wiring.

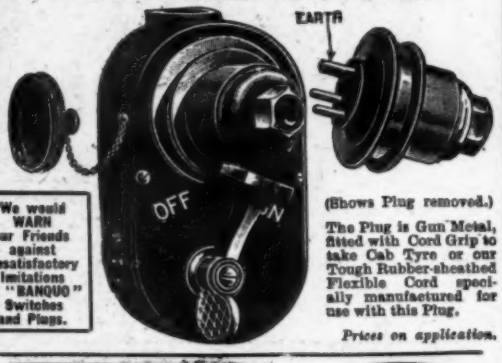
With loose or removable keys, 1/4 per way ex.

NUMBER OF SINGLE POLE 5-AMP. SWITCHES.

1	2	3	4	5	6	7	8	9	10	11	12
5/0	9/4	14/-	18/8	23/4	28/-	32/8	37/4	42/-	46/8	51/4	56/-

Prices for Double-Pole and 10-amp. Switches on application.

"BANQUO" SAFETY INTERLOCKING COMBINED WATERPROOF SWITCH AND 3-PIN PLUG.



We would WARN our Friends against Unsatisfactory Imitations of "BANQUO" Switches and Plugs.

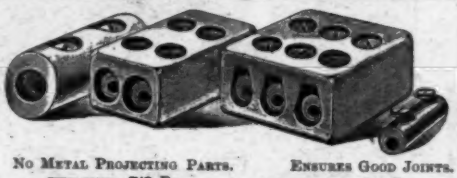
(Shows Plug removed.)

The Plug is Gun Metal, fitted with Cord Grip to take Cab Tyre or our Tough Rubber-sheathed Flexible Cord specially manufactured for use with this Plug.

Prices on application.

"INDISPENSO" China Connectors.

We have designed the "INDISPENSO" CHINA CONNECTOR for positions where very small space is at disposal. Takes up to 7/20 cable.



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PRICES FOR LARGER QUANTITIES ON APPLICATION.

Made in eight different sizes.

DOCK AND FACTORY HEAVY CURRENT WATERTIGHT PLUGS.

As supplied to the War Office, and important Government, Railway and Dock Contracts.

Made in 2 or 3-pin plug type from 10 to 600 amps. capacity.

These plugs are substantially well-made. They are fitted with stout earthing connection, which make connection first and break connection last. A protecting cap is fitted with a chain which prevents the current-carrying parts from exposure when plug is out.

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We hold immense stocks for immediate delivery.

Sizes stocked to hold conduit.

⅜"	½"	1"	1½" dia.
3/-	3/-	4/-	7/- doz.

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SEMI-INDIRECT LIGHTING

ENGLISH and ITALIAN

ALABASTER BOWL FITTINGS.

Complete from **26/-** *each (subj.).*

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IT WILL PAY YOU TO VISIT OUR SHOWROOMS.

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THE WANDSWORTH SWITCHPLUG IS FOOLPROOF

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IT IS SELF-CONTAINED. NO SEPARATE SWITCH IS REQUIRED. IT IS AUTOMATIC IN ACTION, THE RAPID MAKE AND BREAK SWITCH MECHANISM BEING OPERATED BY THE INSERTION OR WITHDRAWAL OF THE PLUG.

IRON CLAD FOR USE IN WORKSHOPS.

MADE IN 5 & 15 AMP. SIZES.

GAS TIGHT.

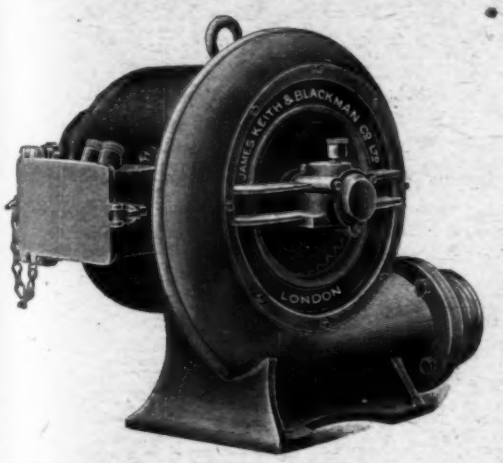
WATER TIGHT.

IRONCLAD
OR
HARD WOOD COVERS.

PORTABLE FANS

PORTABLE FANS SUITABLE FOR SUPPLYING AIR TO CONFINED SPACES—E.G., SHIPS' BOTTOMS AND BILGES, OR MINE SINKINGS, OR VATS, WHEN CLEANING INTERIOR SURFACES, OR FOR BLOWING SURFACE DUST FROM MOTORS, GENERATORS, &c.

FANS ARE SUPPLIED FOR ALL PURPOSES, AND WE SHOULD APPRECIATE YOUR ENQUIRIES.



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PORTABLE
VOLT—AMMETER
Moving Iron.

KELVIN
Portable
Instruments
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A.C.
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Write for Prices.

PORTABLE AMMETER.
3 RANGES SELF-CONTAINED.
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PORTABLE WATTMETER.
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If it's Electrical, it's better Sun Electrical.

Our Booklet "HIGH EFFICIENCY LIGHTING FOR COMMERCIAL and INDUSTRIAL BUILDINGS" is of vital interest to you. WRITE FOR A COPY TO-DAY.

Increase your production and lessen your costs.

THE
SUN DIFFUSA FITTING

by giving a beautifully soft diffused, and, at the same time, adequate light, lessens eye fatigue and increases the output of the workers to an extent that quickly pays for the first cost and maintenance of the lighting. The fitting consists of a highly-polished vitreous-enamelled top reflector with an opalescent bowl. The bowl being suspended at three points, and not by a ring, there are no disagreeable shadows cast. Manufactured in 16 and 18-inch sizes, it is suitable for all half-watt lamps from 100—1000 watts.

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METAL FILAMENT LAMP

Manuractured only by the All-British Lamp Company,

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LIGHT IS A TOOL.

Your production is governed by the efficiency of your lighting and the efficiency of the lighting by the fittings you use.

The above is a photograph of one of the machine shops in our factory, which is a model of efficient lighting.

SEND FOR COMPLETE LIST OF ELECTRIC LIGHT FITTINGS.

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EBONITE-VULCANITE, owing to its special nature, can only be made successfully after many years of experience.

We have been manufacturing this material for

OVER 60 YEARS!

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SHEET, ROD and TUBING
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ACCUMULATOR BOXES (Flexible & Hard).

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Engineers, Cable Makers and Contractors.

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"The old H.T. Feeders were originally laid for 3,300 volts. Five to six years ago, and with the concurrence of the makers, it was decided to run these at the new pressure of 6,600 volts. This has been done, and moreover, they have successfully withstood the application of double the working pressure, viz., 13,200 volts, in order to comply with the B.O.T. requirements, a fact which reflects great credit upon English Cable Manufacturers generally, and upon the makers, Messrs. CALLENDERS particularly."

(Extract from a Paper read on 14th July, 1917, by Mr. H. A. Howie, A.M.I.E.E., A.M.I.Mech. E., Engineer and Manager of the Walsall Electric Supply Department.)

TRADE MARK. **CALLENDER** TRADE MARK.

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Telephone: Holborn, 1910 (Private Exchange). Telegrams: "Callender, Fleet, London."

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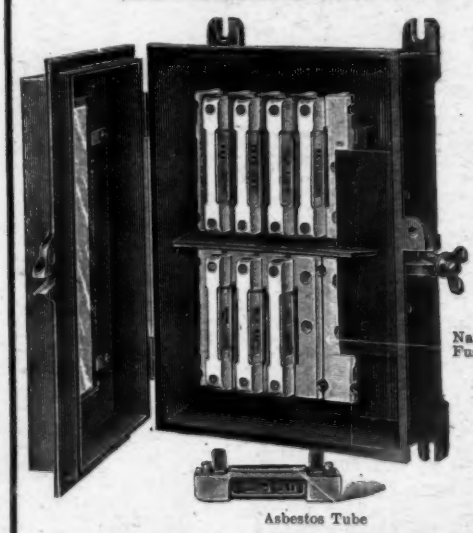
IN TEAK AND IRON CASES.

Made in 5, 10 and 15-amp. ways.



Narrow Slots for Fuse Contacts

Asbestos Tube

DESIGN PATENTED AND REGISTERED.

NOTE THE FOLLOWING POINTS:—

All live metal is completely shielded at the front.
The Fuse Contacts make connection through narrow slots.
The Fuse Wire is enclosed in Asbestos Tubes.
Absolutely non-arcing.
Can be supplied with fixed or hinged battens.

Write for List and Prices.

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Turning, Fitting, Assembling,
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Casters in Ferrous and Non-Ferrous Alloys,
REPETITION TURNING ON CAPSTAN AND SCREW-CUTTING LATHES,
Light Wrought Ironwork, Cutting, Bending, Drilling, Tapping and Rivetting.

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WARD END WORKS, **Company Limited,** **BIRMINGHAM.**

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Of modern design and strong construction, they can be relied upon to give continuous and satisfactory performance, irrespective of working conditions, and without assistance from the repair shop.

High overload capacity with high efficiency.

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75,000 VOLTS FOR ½-HOUR

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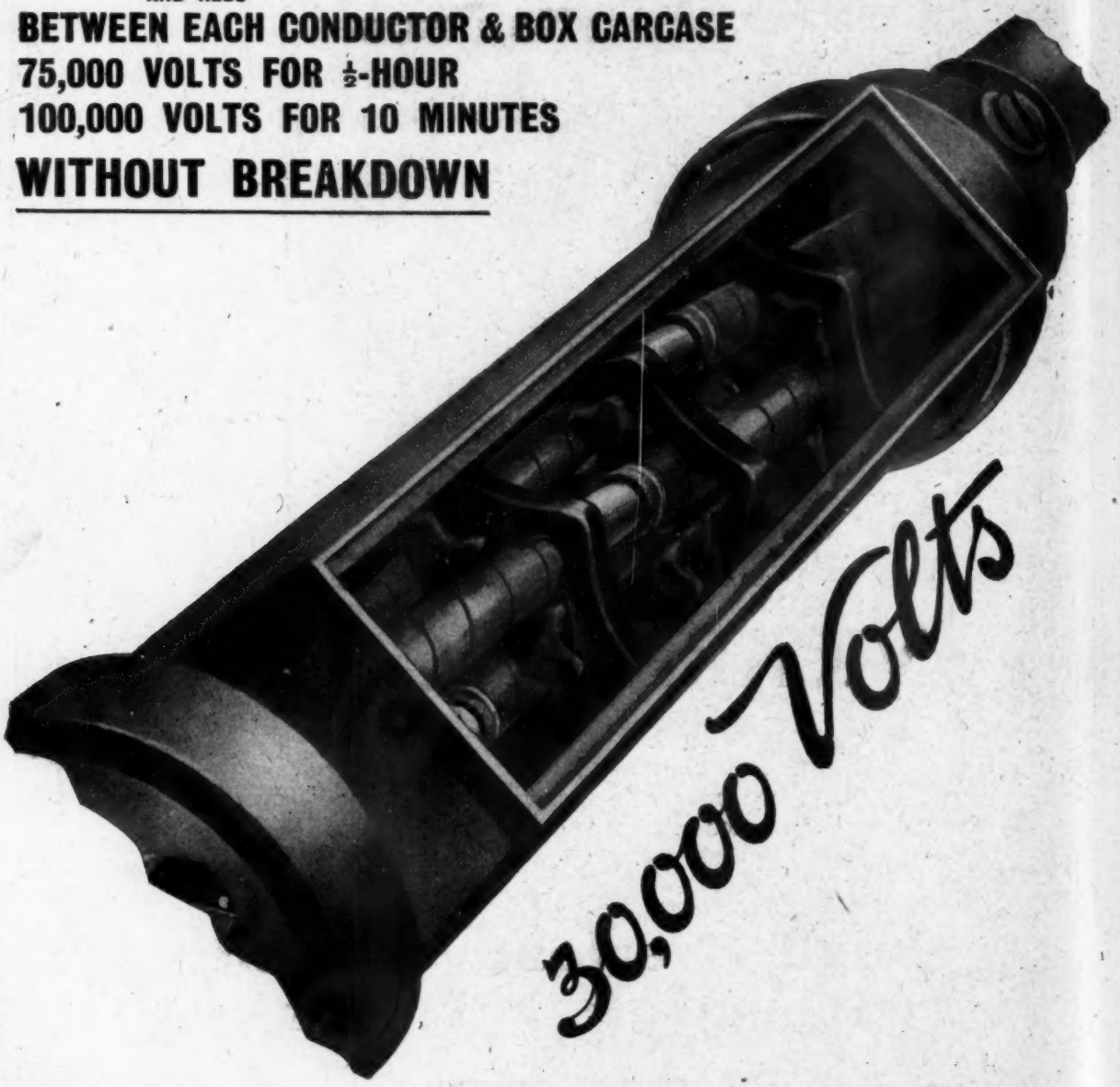

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SITUATIONS VACANT.

Latest time for receiving 9.30 a.m. Thursday.

SENIOR ASSISTANT ELECTRICAL ENGINEERS.

THE NEWCASTLE-UPON-TYNE ELECTRIC SUPPLY CO., LTD., have now several vacancies for Senior Assistant Electrical Engineers for Power and Sub-station work; preference will be given to men who have previously served with the Company as Junior Assistant Engineers, and have been discharged from the Army or Navy.

Applicants must have had experience with large motor generators and rotary converters.

Wage £3 2s., plus 12½ % per week, with time and a half between 10 p.m. Saturday and 10 p.m. Sunday.

Fourteen days' holiday will be granted with full pay for each twelve months' service with the Company.

Applications in writing giving full particulars of theoretical and practical training, together with copies of references and date on which duties could be commenced, should be addressed to THE ENGINEER, Operation Department, Carville Power Station, Wallsend-on-Tyne. 2199

GLOUCESTER CORPORATION ELECTRICITY DEPARTMENT.

CHARGE Engineer, D.C., 3-wire and tramways, seven 8-hour shifts; salary £2 18s., plus 12½%. Can obtain protection certificate if lower than Grade 1.—Apply, enclosing copies of references, to CITY ELECTRICAL ENGINEER, Commercial Road Gloucester. 2205

SITUATIONS VACANT.—*Continued.*

MEXBOROUGH URBAN DISTRICT COUNCIL.

Electricity Department.

CHARGE ENGINEER.

REQUIRED immediately, Charge Engineer with experience of D.C. 3-wire station combined with refuse destructor. Wages £2 12s. per week of 56 hours, plus 12½%; all overtime paid.

Apply stating age, experience, together with testimonials, to the undersigned.

J. B. FELTHAM, A.M.I.E.E.,
Engineer and Manager.

Electricity Works,
Mexborough. 2251

RHONDDA URBAN DISTRICT COUNCIL.

Electricity Department.

JUNIOR SWITCHBOARD ATTENDANT wanted, 8-hour shifts, knowledge of A.C., 3-phase supply a recommendation. Good opening for student. Wages 29s. 6d. per week, plus 9s. war bonus and 12½%. Only applications from those ineligible for the Army will be considered. State age, experience, together with copies of testimonials, to be sent to the undersigned.

J. M. BOWMAN,
Engineer and Manager.

Electricity Works,
Porth, Rhondda. 2245

RADCLIFFE URBAN DISTRICT COUNCIL.

Shift Engineer.

SHIFT ENGINEER wanted, with previous experience in direct current three-wire and traction supplies, high-speed direct-coupled steam sets. Experience with rotary converter equipments will be a recommendation. Wages £3 5s. plus 12½% per week of 56 hours. Certified Undertaking.

Applications, giving experience, age, to be sent to ENGINEER AND MANAGER, Electricity Works, Lomax Street, Radcliffe, Lancashire. 2193

CHARGE ENGINEERS.

CHARGE ENGINEERS wanted for Midland power station, experienced with Turbines, Water-Tube Boilers and E.H.T. three-phase. Salary £3 9s. per week, including all bonuses.

Apply, stating experience, age, and enclose copies of testimonials, to 2192, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHARGE ENGINEER.

CERTIFIED Undertaking has vacancy for Charge Engineer in Power Station. Must have had technical training and experience with steam and E.H.T. three-phase plant. Wages 70s. per week inclusive. Apply with details of experience and copies of recent testimonials. 2182

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

QUEEN MARY'S MILITARY HOSPITAL (COUNTY ASLYLUM) WHALLEY.

WANTED Shift Engineer for the above Institution; experience with high-speed engines, D.C. three-wire system and battery. Wages £3 10s. per week of seven 8-hour shifts, inclusive of bonus. Applications, stating age and qualifications, must be sent in immediately to

THE CLERK AND STEWARD,
Queen Mary's Military Hospital,
Whalley, near Blackburn.

July 30th, 1918. 2225

BOROUGH OF ST. MARYLEBONE.

Electric Supply Department.

APPOINTMENT OF ASSISTANT MAINS ENGINEER.

APPLICATIONS are invited for the post of Assistant to the Mains Engineer at an inclusive salary of £6 per week.

Candidates must have had distribution experience, and are requested to give detailed particulars, accompanied by copies of recent testimonials, addressed to—

THE ACTING CHIEF ENGINEER,
19, York Place, London, W.1. 2215

SHIFT ENGINEER.

SHIFT Engineer wanted for 1500 KW. municipal power station; (certified undertaking). Must be fully qualified man with mechanical and electrical experience.

Applications, stating age, experience, salary required, when able to commence, and form of exemption from military service, accompanied by copies of recent testimonials, to be addressed to 2216, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

ENGINEERS-IN-CHARGE.

JUNIOR Assistants wanted, with mechanical and electrical training, and experience of D.C. and E.H.T. operation. Wage 32s. 6d. plus 20s. plus 12½%.

Write, stating age and experience, to THE ENGINEER AND MANAGER, West Ham Corporation Electric Supply, 84, Romford Road, Stratford, E. 15. 2217

TECHNICAL ENGINEER.

TECHNICAL ENGINEER required to assist in the control of the manufacture of Wireless Telegraphic Apparatus in London. A systematic trend of mind and an intimate knowledge of technical works procedure essential. Nobody on Government work or outside 10-mile radius need apply.

2249, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

SHIFT ENGINEER.

WANTED Shift Engineer for small power station, A.C. and D.C., to run steam engines and switchboard.

Apply, giving previous experience and wages required, to—

MANAGER,
Electricity Works, Stamford. 2208

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
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A LARGE Manufacturing Company require immediately, a Senior Control Room Attendant for their Power House. Commencing salary £4 5s. per week of 56 hours, inclusive of all awards and bonuses to date.—Apply, giving particulars of E.H.T. experience, to 2227, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winders, used to repair shop, D.C. work. No person resident more than 10 miles away, or already on Government work, will be engaged.—Apply H. D. & S., 32, Newington Causeway, S.E. 1686

BOURNEMOUTH. Man wanted to take charge of Generating Plant in general departmental store. Must be accustomed to gas engines, and with knowledge of electric wiring preferred. Permanent, progressive position, discharged man (navy) preferred. —Apply MANAGING DIRECTOR, Bright's, Ltd., Bournemouth. 5171

CHARGE Engineer (Junior) wanted, D.C. and A.C. Certified Undertaking, to take light shifts and train for heavy. Pay £3 weekly, including all bonuses to date.—Apply with full particulars, age, training and experience, to 2194, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHARGE Engineer wanted for combined A.C. and D.C. station in Scotland.—Apply stating age, experience and wage required, to 2166, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DESIGNING Engineer for electrical machines wanted by large firm in Midlands. Must be thoroughly experienced mechanical man with good shop experience. No person already on Government work will be engaged.—Apply, stating experience, age, and salary required, to your nearest EMPLOYMENT EXCHANGE, mentioning this paper and No. A5684. 2069

SITUATIONS VACANT.—*Continued.*

DRAUGHTSMAN required, preferably experienced in L.T. switchboard work and accessories; Birmingham district. No one already on Government work will be considered.—Apply, stating fully, experience, age, and salary required, to nearest EMPLOYMENT EXCHANGE, quoting No. A5790. 5215

DRAUGHTSMAN wanted by London electrical manufacturing company. No person resident more than 10 miles away, or already on Government work, will be engaged.—Apply, stating details of experience, and salary required, to 2202, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRIC Lamps.—Man wanted with practical knowledge of exhausting and capable of doing repairs. No one already on Government work, or residing more than 10 miles away, will be engaged.—RENEW LAMP CO., 847, Harrow Road, N.W. 10. 5133

ELECTRICAL Fitter required for general maintenance, used to A.C. work; good reference required; standard rate.—Apply MANAGER, Electric Power Station, Brimsdown, N. 5219

ELECTRICAL Fitter wanted for Generating Works. Preference given to man who has had previous experience on high-tension work. Inclusive wage 66s. 4d. for 53-hour week.—2132, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Fitter wanted with Tramway Motor experience. —Write or call MANAGER, 590, Lea Bridge Road, Leyton, E. 10. 1777

ELECTRICAL Foreman wanted shortly for Clyde shipbuilding yard. Must have had experience of large contracts for Admiralty and Mercantile ship installation; a strict disciplinarian, good organiser and energetic man essential. No one already on Government work need apply.—Give full particulars, experience, age, and salary expected, to your nearest EMPLOYMENT EXCHANGE, mentioning No. A5700. 5082

ELECTRICIAN required to take charge of, and run small plant consisting of water-power turbines and auxiliary oil engine. To carry out installations and repairs.—Apply, stating age and wages required, to SECRETARY, Dulverton Electric Lighting Co., Ltd., Dulverton, Somerset. 5182

ELECTRICIAN. Take charge private installation, suction gas engines; must be ineligible for Army.—5234, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRO-Plater.—Charge hand wanted for polishing, plating, and enamelling department of a Government controlled electrical firm. London district. Permanency for suitable man. Applicant must not be engaged on Government work, or resident more than 10 miles away.—Write, giving full particulars of experience and stating wages required, 2221, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER, with experience of both A.C. and D.C. plant, wanted to take charge of shift in certified electricity works, South of England. Commencing wage 40s. plus 20s. plus 12½ per cent.—2171, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTIMATING Engineer required immedialely for control gear sales department, electric engineering work. South coast.—Apply, stating age, qualifications, and salary required, to 2213, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EXPERIENCED Electrician wanted at once to take charge of lighting and power in Government controlled establishment. No one already engaged on Government work or residing more than 10 miles away will be engaged.—Write, giving full particulars of experience and salary, to BOX 539, c/o Mitchell's Advertising Agency, 1, Snow Hill, E.C. 1. 5203

EXPERIENCED Foreman or Forewoman required to take charge of flashing and mounting department, carbon filaments. No person resident more than 10 miles away, or already on Government work, will be engaged.—9728, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN wanted for machine shop by firm of manufacturing engineers; must have experience in the efficient handling of small repetition work; good organiser and disciplinarian essential; experience of welding and light sheet-iron work an additional recommendation. No person already on Government work will be engaged.—Apply, giving age, experience, salary, &c., to your nearest EMPLOYMENT EXCHANGE, mentioning No. A5781. 2210

GENERAL Manager required by well-established electrical contractors in Midlands, chiefly engaged at present on war work; must be experienced in estimating power, light, telephone contracts, also handling men.—Full particulars, age, experience, and salary required, to WM. IRONS, Solicitor, St. James Street, Sheffield. 5196

HOTEL Electrician-Engineer required for first-class hotel on sea-front. Duties include full charge of electrical plant, hotel heating and steam apparatus. Stoker employed. Sleep and board out. Should have had previous experience in hotels, or upkeep of private plant, gas engines, battery, telephones, &c.—Apply, giving copies of testimonials, state age, salary expected, to MANAGER, South-Eastern Hotel, Deal. 2141

IMPROVER required in Corporation Generation Station; applicants to be ineligible for military service or in a low medical category. —Apply, stating age, experience, and wages required, to 2252, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

JUNIOR Shift Engineer required for large electric power station (certified undertaking), A.C. and D.C. Good experience and prospects. Wages £2 15s. weekly, inclusive rate.—Apply SHROPSHIRE, WORCESTERSHIRE & STAFFORDSHIRE ELECTRIC POWER CO., Power Station, Downing Street, Smethwick. 2224

JUNIOR Shift Engineer wanted, D.C. station; 30s., plus war bonus, 20s. and 12½%.—Apply, with full particulars, experience, age, &c., to BOROUGH ELECTRICAL ENGINEER, Electricity Works, Tottenham Lane, N. 8. 5220

SHIFT Engineer wanted in State Controlled establishment, to take charge of alternate day and night shift. Diesel and gas engines, D.C. plant. Only men not engaged on Government work, and free from military service, also thoroughly experienced, need apply.—Applications, giving full particulars, to be made to your nearest EMPLOYMENT EXCHANGE, mentioning No. A5483. 2226

SWITCHBOARD and Substation Attendant wanted for large Power Station and Battery Substations; experienced with 3-wire D.C. system with batteries and boosters and also preferably with A.C. plant and rotary converters. Good wages with war bonus per week of seven 8-hour shifts, plus 12½ %. No person already employed on Government work will be engaged.—Apply your nearest EMPLOYMENT EXCHANGE, giving full particulars of training and experience and stating military category, and mentioning No. A5819. 2214

SWITCHBOARD Attendant required for three-wire D.C. station.—Apply, stating age, full particulars of experience, and wages required, to 2250, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Armature Winder accustomed to the rewind and repair of tramway armatures, Brush and B.T.H.; wages, inclusive of all bonuses to date, 1s. 4d. per hour.—Apply to MANAGER, Mexbro' & Swinton Tramways, Dale Road, Rawmarsh, giving full particulars, &c. 2246

WANTED at once for London station, Shift Engineer; wages to commence £3 15s. to £4 per week, according to ability.—2190, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, by a firm in the S.E. district engaged on munition work, first-class Telegraph Mechanics. No person resident more than 10 miles away, or already engaged on Government work, will be engaged.—State age and experience to 6125, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, by leading engineering insurance company, Electrical Surveyors, having good knowledge of the theory and practice of alternating and direct-current plant.—Applicants must be ineligible for the Army or Navy.—2181, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED Charge Engineer for A.C. and D.C. station; steam turbines, water tube boilers; certified undertaking. Salary 60s. plus 12½%.—Write BOROUGH ELECTRICAL ENGINEER, Municipal Offices, Cheltenham. 5207

WANTED, Electrical Engineer with a knowledge of D.C. machine design. Nobody engaged on Government work need apply.—Apply, giving particulars of age, experience, and salary required, to SIEMENS BROTHERS DYNAMO WORKS, LTD., Stafford. 2083

WANTED, for country house, Electrician Handy-man, ineligible for military service, to run electric light plant, accumulators, telephones, bells, capable of doing small repairs, and general handy jobs.—Apply stating age, experience, references and wages required, to MISS WHITEHEAD, Wilmington Manor, near Dartford, Kent. 5151

WANTED for Government establishment in West of England Mechanics with good all-round experience of telephone installation and maintenance work, and preferably familiar with C.B.S., C.B.S.-multiple and intercommunication systems and switchboards. No person already on Government work will be engaged.—Apply, giving age, full particulars of experience, and military category if graded, to your nearest EMPLOYMENT EXCHANGE, mentioning No. A5818. 2209

WANTED, General Assistant to Works Manager in an old-established electric lamp factory. Good opening and progressive salary. No person already on Government work will be engaged.—Apply your nearest EMPLOYMENT EXCHANGE, mentioning No. A5667. 2037

WANTED, man (ineligible) to take charge of electric lighting and pumping plant on estate in Berkshire.—Apply stating experience, wages, references, &c., to 5154, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED Man or Youth and Girl used to flash lamp battery making. No person resident more than 10 miles away, or already on Government work, will be engaged.—Apply WALLACE, 58, High Street, Bloomsbury. 5218

WANTED on a Scottish Power Company (Certified Undertaking), a Shift Engineer with good mechanical and electrical training. Good wages to a man thoroughly experienced in E.H.T. 3-phase work and boiler house control.—Reply giving full particulars, with copies of references, to 1975, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

WANTED, Overhead Linesman accustomed to tramway work, ineligible for military service. Good wages. — Apply GENERAL MANAGER, Tramway Depot, Greenock, N.B. 2198

WANTED, representatives for (a) London district and South; (b) Birmingham district; (c) Bristol and district; with practical knowledge of electrical engineering. Real live men, good remuneration.—Write THE METALLIC ELECTRICAL ENGINEERING CO., LTD., 153, Corporation Street, Birmingham. 2212

WANTED, Working Foreman, experienced in alternating, single, three-phase and 500-volt tramway current, also thoroughly experienced in maintenance work, electric lighting and power motors. Permanent situation to qualified and capable man. Apply with references. No person already on Government work will be engaged.—Apply your nearest EMPLOYMENT EXCHANGE, mentioning No. A5767. 5178

YOUTH wanted to assist in drawing office of London electrical manufacturing company. No person resident more than 10 miles away, or already on Government work, will be engaged.—2203, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
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ADVERTISER, Engineer and Manager to supply undertaking, desires change; 16 years' central station experience. Good organiser and accustomed to the control of men. Commencing salary £350 for permanent post.—5205, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER seeks change. Charge, maintenance steam, Diesel, electrical plant. Low category. Particulars; salary offered.—5217, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, 18 years' experience testing laboratories, power stations and works, requires change, meters, instruments, motors and dynamos, cables and batteries.—5104, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Commercial Manager, 14 years' general supply station and contracting experience, desires post progressive firm. Ineligible, energetic, highest refs.—5179, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer desires an appointment; over 12 years' experience in the generation and distribution of electrical energy.—5175, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CHARGE Engineer desires change; good mechanical and electrical experience; Grade 2.—5117, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN (Junior).—Youth, 16½ years, just left technical school, requires situation with Electrical Engineers.—YOUNG, 153, Taybridge Road, Battersea, S.W. 11. 5099

ELECTRICAL and Mechanical Engineer, A.M.I.E.E., A.M.I.M.E., age 42 years; workshop training, 20 years' central station plant mains, tramways experience in responsible positions, 10 years in present post, desires change, first-class references; salary about £350 for permanent post.—5085, ELECTRICAL REVIEW, 4, Ludgate Hill, London

ELECTRICAL and Mechanical Engineer, specialising in electro-plating, is free to accept responsible position where such knowledge can be utilised. Would lay-out and supervise erection and operation of plant for quantative production.—5231, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer Designer (29) desires change. Good technical education; five years' works experience; six years commercial and design, D.C. and A.C. machinery. Government work in Yorkshire, West Riding, preferred.—5143. ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, full of energy and enterprise, shortly disengaged; used to control of men, capable organiser with initiative, keen buyer, good estimator, and well up in theory and practice, present sales engineer to supply company; work of national importance essential, 20 years' experience, excellent references.—5121, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer. Fully qualified in construction work and estimating contracts, &c.—5197, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (34), ineligible, desires permanent responsible post; thoroughly experienced central station, mains and installation management; salary round £250.—5193, ELECTRICAL REVIEW, 4, Ludgate Hill, London

ELECTRICAL Fitter (28) Grade 3, desires change, health reasons, Cornwall and West Country preferred; experienced in all inside and outside central-station and factory routine.—5093, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ELECTRICIAN (age 35) desires berth of national importance. Thoroughly experienced with dynamos, motors, lighting accumulators, erecting and own repairs; conversant with steam practice.—BROWN, 601, Romford Road, Forest Gate, London, E. 7. 5233

ELECTRICIAN Assistant wants job; London or Country work. age 17.—W., 124, Brondesbury Villas, Kilburn, N.W. 6. 5201

ELECTRICIAN, light, power, telephones, instal, maintain, repairs, seeks job or charge.—JONES, 44, Warwick Road, Edmonton. 5210

ELECTRICIAN, mechanic, seeks situation; work of national importance (44). Medical category, grade 3.—BRAY, 180, Finborough Road, S.W. 10. 5230

ELECTRICIAN or Shift Engineer, seeks berth,—A.C. and D.C., erection of installations, plant, or station work.—5080, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN-Jointer (26), D.C., paper, jute, lead, armoured, 3 and 4-cored and concentric cables, feeders, motors, lighting, 'phones, bells, conduit, casing, 11 years' experience, desires permanency; discharged.—HILLIER, Paul Street, Frome, Somerset. 5192

ENGINEER, working, 14 years' experience, seeks charge of plant-controlled works, doing all own repairs. Erecting, &c., both electrical and mechanical. Excellent testimonials. London or suburbs.—5109, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ESTIMATING Foreman Electrician, 10 years' in present situation, wants change.—"ENGINEER," 23, Grotto Road, Twickenham. 5224

METER Superintendent desires change; conversant with leading types A.C. and D.C. meters and instruments, installation testing, records, &c.—5223, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TELEPHONE Engineer (31), grade 3, recently returned from Far East; 15 years' practical experience in all branches, outside engineering a speciality, seeks situation (work of national importance) where initiative and ability are required.—5206, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, full experience, ineligible, open for engagement.—G., 49, South View Road, N. 8. 5204

WIREMAN (27), used screwed tubing, repairs, desires permanency, work of notional importance, London; present engaged munitions factory.—5225, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WORKS Electrician, sound practical experience with all types A.C. and D.C. plant.—W. SWINDEN, 41, Rothschild Road, Chiswick Park, W. 4. 5235

YOUNG Lady desires re-engagement; 5 years' electrical trade; shorthand, typing, book-keeping; 40s. to 50s.—5212, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PARTNERSHIP.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
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ENGINEERING Works fully equipped producing Electrical Accessories, requires additional capital to cope with large orders in hand. Prepared to consider any sound proposition, including acquisition; appliances manufactured, universally used; production costs exceptionally good owing to unique designs fully patented; labour obtainable and buildings available for further extention. Fullest investigation invited.—5202, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

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AN important London firm of merchants with special electrical department wishes to represent in Italy, France, Switzerland, and Spain, firms manufacturing electrical porcelain insulators and fittings, also electrical lamps and/or other articles for electrical industry.—Write, giving full particulars, stating terms, to 5091, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, shortly proceeding to South America, would undertake good agency—electrical plant, &c. Direct touch with shipping and engineering.—Write H., c/o Streets, 30, Cornhill, E.C. 3. 2163

FIRMS with good connections wanted to sell enclosed pattern Electric Hotplates. Good profits. Quick sales. Delivery from stock.—5147, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

MACHINERY FOR SALE.

50-KW. Steam Generating Set, by Scott & Mountain, direct coupled to Generator, 500 volts, 100 amps., 500 revs.

25-KW. Steam Generating Set, two crank Comp. Engines, direct coupled to two-pole Dynamo, 100 volts, 250 amps., 450 revs.

6·5-KW. Steam Generating Set, by Robey & Co., direct coupled to two-pole Dynamo, 130 volts, 50 amps., 350 revs.

250-KW. Steam Generating Sets, by Willans & Robinson, direct coupled to Clarke Chapman Dynamo, 115 volts, 435 amps., 470 revs.

No. 3 Four-spindle "Acme" Automatic Screw Machine for ¾" bars.

3½" Centres "Lo-Swing" Lathe on 8' bed.

8" by 36" All-geared head Flat Capstan Lathe, by Jones and Lamson.

Cutting-off Machine, by Carter & Wright, take bars to 5' diam.

6 ft. Arm Portable Electric Radial Drilling Machine, by Kendal & Gent, 2½" spindles, self-act feed.

Richards Horizontal Oil Groove or Waving Machine, with self-act traverse head, self-act feed, T-slotted bed, 2' 2" by 2' 3"

CATALOGUE of Stock MACHINERY. 2-3000 LOTS.
Free on Application. Inspection invited.
THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

R. H. LONGBOTHAM & CO., LTD., WAKEFIELD,
and at Milburn House, Newcastle-on-Tyne.

Tel.: 44 Wakefield. 867 Newcastle. Telegrams: "Engineer, Wakefield."

FOR SALE.

ONE Parsons Steam Turbo Set, 3500 KW., 1200 R.P.M., with alternator field-rotating type and exciter complete; 6000-volt maximum load, 40 cycles.

One ditto, 1500 KW., 2-phase, 2000 volts, 50 periods.

One Willans-Parsons Steam Turbo Set, 1200 KW., with Alternator, 1200 R.P.M., 200 lbs. to sq. in., 11,000 volts, three-phase, complete with exciter, also condensing plant, air, and circulating water pumps, &c.

One Parsons Turbo-Alternator, 800 KW., two-phase, 2600 volts, 50 periods.

One Surface Condenser, 3,400 sq. ft., Cooling Surface, by Cole, Marchent & Morley, complete with pumps, &c. 5277

MACHINERY FOR SALE.

ONE 80-H.P., 400/500-volt, three-phase, slip-ring 50-period Motor, 1450 R.P.M., fitted with brush-lifting and short-circuiting device. Oil-immersed rotary starter and switch case, comprising 3-pole switch, no-volt and overload release, and ammeter.

Two 30-H.P., 480/530-volt, D.C., shunt-interpole Motors, 900 R.P.M. complete.

One 20-H.P., 220-volt, D.C. shunt, totally-enclosed Motor, 900 R.P.M. complete.

One 20-H.P., 200-volt, D.C. compound, interpole Motor, 800 R.P.M. complete.

Two 130-H.P., 200-volt, shunt, 3-pedestal bearing Motors, 300 R.P.M., with special switch pillars.

One 9-KW., 125-volt, compound Dynamo, 900 R.P.M.

Two 8-H.P., 200-volt, shunt interpole Motors, 1400 R.P.M. complete.

Two Cinema Motor Generator Sets.

THE VICTORIA ELECTRIC PLANT CO.,
Spenser Street, Westminster, S.W. 1.
'Phone: Victoria 4026. 'Grams: Vicminster, Sowest, London. 2179

MACHINERY FOR SALE.

ONE Generating Set Comprising:—

"Howden" Enclosed Compound Engine for 150 lbs. steam pressure, direct-coupled to compound interpole generator, having an output of 300 KW, at 240 volts, 375 r.p.m.; built in 1910, and in first-class order.

Specification and print on request.

THE PHŒNIX ELECTRICAL CO.,
32—36, Broomielaw, Glasgow. 1943

(Continued on next page.)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

GENERATING SETS, D.C.

One 500-KW. Willans-E.C.C., 420/500 volts.
Three 256-KW. Belliss-Siemens, 460/500 volts.
One 220-KW. Willans-A.E.G., 220 volts.
One 200-KW. Allen-Parker, 460/500 volts.
One 180-KW. Anderson-Mavor 220/230-volt Set.
One 160-KW. Belliss-G.E.C., 460/500 volts.

TURBO-GENERATORS, A.C. AND D.C.

One 1,000-KW. A.E.G. 500 volts, 50 cycles, 3-phase, with condensing plant complete; the whole equal to new.
One 500-KW. Parsons, 460/530 volts, with condensing plant complete.

Apply, FRANK GILMAN,
Lightwoods Hill, Birmingham. 2128

MACHINERY FOR SALE.

GENERATING SETS.

TWO Siemens 6-pole Generators, 410 V., D.C., 550 amps., 360 revs., with two Triple-expansion Engines, 360 H.P., 360 revs. Will sell separately.

MOTORS AND GENERATORS.

54 KW., Hall's, 440 V., D.C., 470 revs.
75 KW., E.C.C., 110 V., D.C., 550 revs.
20 H.P., Brooks, 110 V., D.C., 880 revs.
15 H.P., Westinghouse, 500 V., D.C., 650 revs.
20 H.P., Brooks, 220 V., D.C., direct coupled to 4" vertical pump, 100 ft. head.
600 H.P., S.R., 2000 V., 2-phase, 50 periods, 730 revs.
31 H.P., S.C., 500 V., 3-phase, 50 periods, 1440 revs.
11 H.P., S.R., 400 V., 3-phase, 50 periods, 960 revs.

BURY ELECTRICAL PLANT CO., LTD.,
Phœnix Street, Bury.
'Grams: "Electric, Bury." 'Phone: 676 Bury. 2185

COUNTY BOROUGH OF WALLASEY.

Surplus Plant.

THE Electricity Department of the Wallasey Corporation have for immediate disposal—

Single-phase 2,000 volts, direct-coupled triple-expansion Generating Set, 500 KW.
Also the wood in two water cooling towers, as fixed.
Three sets of Condensing Plant.
One Green's Economiser, containing 320 tubes.

Full particulars may be obtained on application to the BOROUGH ELECTRICAL ENGINEER, Seaview Road, Wallasey.

Offers to be sent in not later than 26th AUGUST, 1918.

The Council do not bind themselves to accept the highest or any tender.

By Order,
H. W. COOK,
Town Hall, Wallasey. *Town Clerk,*
29th July, 1918. 2247

FOR SALE.

ONE Cole, Marchent & Morley Cross-Compound VERTICAL CORLISS STEAM ENGINE and engine type Westinghouse D.C. GENERATOR; complete with Condenser, Air Pumps, Grease Extractor, Steam and Exhaust Pipes, and, if required, electric cables, switches, circuit breaker and rheostat.

Capacity: 1000 KW. at 85 R.P.M., with steam at 160/180 lbs. pressure. Generator shunt and compound wound, 460/550 volts.

In excellent condition. Can be seen running, and prospective purchasers can witness steam consumption tests. The engine can be used for rope driving by removing the generator armature and substituting a rope pulley.

Apply—
ELECTRICITY DEPARTMENT,
Town Hall,
Bradford. 8583

FOR SALE.

DYNAMOS, 100 V., 220 A., 900 revs. (Mather & Platt), compound, with spare armature.
110 V., 50 A., 1,100 revs. (Scott), shunt.
500 V., 120 A., 500 revs. (Crompton), 6-pole, interpole single bearing.
230 V., 65 A., 650 revs. (Brush), 4-pole, compound, single bearing.
Motor-generator, 230 V. to 65 V., 40 A. (Newton).
Porthole fan, 24-in., 230 V., 800 revs.
Three Siemens Mining Switches, double automatic, 300 A., 3-pole.
"Robey" Vertical Steam Engine, 10 and 14 × 9 inch.
"Gardner," 1½ H.P., Horizontal Oil Engine, with base to take belt-driven dynamo.
Motors, all sizes, A.C. and D.C.
Switchboards, Cable from 61/12A., Resistances, Carbon Lamps (60 and 65 V., 32 C.P.), Shades, Meters, &c. Send enquiries.
MERCIER, 25, Union Street, Liverpool. 2067

FOR SALE.—*Continued.*

GAS ENGINES AND ALTERNATOR.

FOR Sale, 10-B.H.P. Andrews Stockport Gas Engine, two fly-wheels and pulley, tube ignition.

89-B.H.P. Crossley Gas Engine, X.A.E. type, with extra heavy fly-wheel, electric lighting engine, magneto ignition.

142-B.H.P. Crossley Gas Engine, Z.A.E. type, with extra heavy fly-wheel, electric lighting engine, magneto ignition.

One 70-KW. Elwell-Parker single-phase Alternator, wound for 110 or 220 volts, with separate exciter.

Can be seen running.

CRYSELCO LIMITED, Kempston Works, Bedford. 2107

TURBO-GENERATOR.

1,000-KW. TURBO-GENERATOR, 500 volts, 50 periods, 3-phase, complete with Switchboard, Cables, Surface Condensing Plant, Piping, and Electrically-Driven Centrifugal Pump, together with a quantity of Spare Parts, the whole practically new and ready for immediate despatch at Liverpool.

Apply—
FRANK GILMAN,
Lightwoods Hill, Birmingham. 2170

ELECTRIC DYNAMOS AND MOTORS.

MACHINES always available for Sale or hire. ARMATURES and FIELD COILS rewound or repaired without delay.

'Phone: 5773 Holborn. MACDONALD, SYER & CO., LTD., 295, Gray's Inn Road, W.C. 1. 8485

WATER-TUBE BOILERS.

FOR Sale, two Babcock & Wilcox Water-tube Boilers, 12,000 lbs. capacity, complete with superheaters, chain grate stokers, &c. —Full particulars on application to the

BOROUGH ELECTRICAL ENGINEER,
9, Iron Gate, Derby. 2167

ELECTRIC MOTORS.

SALE or Hire. Second-hand Machines in Stock. ARMATURES and Coils repaired at shortest notice.

THE TITAN ELECTRICAL CO.,
9/11, Eagle Street, W.C.
'Phone: Central 13,191.

FOR SALE.

250,000 CLEAR and Half-opal (2·5, 3·5) Bulbs; 10 cwt., gauge classes, ⅞" dia., assorted lengths; 200 2, 3, 4-light Electric Pendants; 5 gross 5 amp. Bow Cut-outs; Conduit Fittings, plain and screwed.

Big discount off list.

2211, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

FOR SALE.

THIS week's special offers:—
PARAFFIN WAX, 124/6, at 11d. lb.; 139/40 SCOTCH REFINED, 1s. 1d. lb.; 135/40 REFINED, 1s. 1d. lb.
BEESWAX, pure yellow, £11 5s. cwt.
JAPAN WAX, £6 9s. cwt. Special quotations for ton lots.
NEWMAN & McKAY, 56, City Road, E.C.
London Wall 1996. 5222

CUNNINGHAM, LIMITED.

SMALL Motors and up to 300 H.P. rewound and repaired.

Estimates free. 171, Edgware Road,
'Phone: "5173 Padd." London, W. 2.

JAPANESE TORCH CASES.

10,000 2-cell Baby, with American switch and bulb, 11s. 6d. per doz.; 5,000 3-cell ditto, 15s. 6d. per doz.; 5,000 2-cell Large ditto, 14s. per doz.; 1,000 3-cell ditto, 16s. 9d. per doz. The above are in stock in London for immediate delivery for spot cash.

2175, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

MOTOR FOR SALE.

300-B.H.P., 500-volt, 3-phase, 50-period, 585 R.P.M. Motor, complete, for sale. Immediate delivery.

2191, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

(*Continued on next page.*)

FOR SALE.—*Continued.*

Cheap prepaid Advertisements relating to second-hand goods and specified Articles are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).

TRADE RATES ON APPLICATION.

Box Number and ELECTRICAL REVIEW address count as seven words.

A.C. Motors, 2-phase, 200 v., 50 ~, 2, 4, 6, 7½, 15, 20, 25, 30, 50, 60 H.P.; single-phase Motors, ½/10 H.P., 100/200 v.; several 190 H.P., 3-phase, 550 v., 50 ~ Motors; 1, 30, 50, 100 H.P., 3-phase, 440 v., 50 ~, Motors and Starters.—5239, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CAMERON Boiler Feed Pump, duplex 5" stroke × 3" rams gun metal, 125 lbs. boiler pressure. Duplex Hydraulic Pump, single acting, 1¼" rams, 9" stroke, 125 lbs. boiler pressure. Water pressure 800 to 1000 lbs. per square inch.—"ROBUST MACHINERY," 62, Bradford Street, Walsall. 2130

D.C. Motors, 230 v., ¼, ½, ¾, 1, 1½, 2, 3, 4, 5, 7, 10, 20 H.P.; D. Motors, 460 v., 1, 2, 3½, 5, 6, 10, 18, 30 H.P.; Motors, 110 v., ¼, ½, 1, 2, 3, 4, 5, 7, 8, 9, 10, 20, 25, 70, 100 H.P.—5238, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

D.C. Starters, to 150 H.P., in all types; Shunt Regulators, all sizes; Voltmeters, Ammeters, Ohmmeter and Generators, 500 v.; ½-H.P., 200-v., 100 ~, single-phase Motor, £8 10s.—5240, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DYNAMOS, 200/250 v., 21, 45, 60, 100, 180, 400, 650 amps.; Dynamos, 110 v., 12, 20, 26, 40, 50, 60, 70, 90, 100, 125, 300, 520 amps.; several 60/80 v., 60/100 a.—5236, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DYNAMOS, 3000, 1500, 1000 and 750 amperes at 6 volts; also smaller sizes. Apply for lists.—CANNING & Co., Electro-Platers Engineers, Birmingham. 7769

ELECTRIC Lamps.—Three dozen 30-watt, six dozen 20-watt, three dozen 17-watt, and two dozen candle lamps, 100-C.P. Osram, half-used (metallic), for sale; also 50-amp. 100-volt Aron Meter. Am changing supply from 100 direct to 200 alternating. Offers wanted.—J. A. PYNE, 39, Honor Oak Road, Forest Hill, S.E. 23. 5213

ELECTRIC Motors and Dynamos, Sale or Hire. Always a large stock of nearly new guaranteed machines. Immediate delivery.—ELECTRO-GENERATOR CO., 1A, Shepherd's Bush Road, W. 'Phone: 488 Hammersmith. 4723

ELECTRIC Vehicles. Four three-wheel Vans, motor fitted in the front wheel, all with solid rubber tyres, one fitted with batteries. Cheap for quick sale.—HYAMS, 11, Glengall Terrace, Old Kent Road, S.E. 5156

FOR Sale, about 1 ton Mica Flake and 5 cwt. Mica Dust. In London.—2112, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, eight 20-H.P., 500-volt, totally-enclosed Crane Motors. Cheap.—PHŒNIX, 32, Broomielaw, Glasgow. 2233

FOR Sale, Morris Pulley Blocks for 5 tons (only used on one job), £22; one 200-ampere Switch and Fuses on slate, D.P., with ammeter and voltmeter, 500 volts (£16), new.—2253, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, one 200-H.P. triple-expansion single-acting high-speed Engine, enclosed type, 300 R.P.M., by Willans and Robinson, Ltd., fitted with extended soleplate for carrying dynamo, price £100.—On view at JARDINE'S, Chelsea Street, Nottingham. 2218

FOR Sale, one 300-KW. 50-cycle, 300 R.P.M., 3-phase A.E.G., 3-bearing Generator, complete with 52" rope pulley with 16 grooves for 1¾" ropes. Also one 60-amp., 110-volt exciter for same, in exceedingly good condition.—Apply ASA LEES & Co., LIMITED, Oldham. 2248

FOR Sale or Hire, 36 D.C. Motors and 13 A.C. Motors. Particulars on request.—E. P. ALLAM & Co., 107, Gray's Inn Road, W.C. 1. Holborn 1280. 2219

FOR Sale, owing to extension and re-arrangement of power plant, a nearly new 600-KW., 460-volt, generating set by Westinghouse. Plant can be seen under steam up till end of August.—2243, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, second-hand 400-volt, 50-period, 3-phase Motors, 25, 30, 40 and 60 H.P., complete with starting gear.—PHŒNIX, 32, Broomielaw, Glasgow. 2236

FOR Sale, Traction Booster, comprising: 218-H.P., 440-H.P. motor, coupled to 150-K.W., 550-volt generator. Makers: Brush Electrical Engineering Co., Ltd. Little used.—2242, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR Sale, Transformer (Foster's), 200 primary, 25 sec., 100 periods, 50 amps.; £3 10s. Four Bell Indicators: 12-hole electrical replacement, 3-hole electrical replacement, 12-hole mechanical replacement, 2-hole mechanical replacement. In new condition, £2.—7, Bavent Road, Camberwell. 5227

FOR Sale, Transformer, 440 volts, 50 periods, 3-phase, to 100 volts, 170 amperes, single-phase. £27.—PHŒNIX, 32, Broomielaw, Glasgow. 2234

FOR Sale, two 50-KW., 230-volt, multipolar, shunt-wound Generators or Motors.—PHŒNIX, 32, Broomielaw, Glasgow. 2241

FOR Sale, 15-H.P., 400-volt, 50-period, 3-phase, squirrel-cage Motor, with spur reduction gear, having a ratio of 4 to 1, complete with starter.—PHŒNIX, 32, Broomielaw, Glasgow. 2237

FOR SALE.—*Continued.*

FOR Sale, 140-H.P., 440-volt, 40-period, 245 R.P.M., 3-phase, slip-ring, 2-bearing Motor. Complete with starter.—PHŒNIX, 32, Broomielaw, Glasgow. 2240

FOR Sale, 140-KW., 550-volt, 400 R.P.M., 6-pole, compound, single-bearing Generator, by Siemens. £350.—PHŒNIX, 32, Broomielaw, Glasgow. 2239

FOR Sale, 150-H.P., 440-volt, 50-period, 285 R.P.M., 3-phase, slip-ring type Motor, with starter. In new condition.—PHŒNIX, 32, Broomielaw, Glasgow. 2235

FOR Sale, 220-H.P., 460-volt, 230 R.P.M., 6-pole, shunt-wound Motor.—PHŒNIX, 32, Broomielaw, Glasgow. 2238

GENERATOR, B.T.H., 27½ KW., 250 volts, 850 R.P.M., with switchboard.—MARTINS, 320, Witton Road, Birmingham. 5232

HAIRDRESSER'S Dryer, hot and cold, 100/125 v., D.C., almost new, perfect condition; price 57s. 6d.; call after 6.—ELECTRICIAN, 145, High Holborn. 5208

LAMP Caps on sale.—50,000 selected metal filament Lamp Caps suitable for re-manufacture.—HAMPSONS, 141, Higher Cambridge Street, Manchester. 4929

MOTOR-Generator in first-class condition, having Motor 480 volts, D.C., and Generator, 60 volts, 50 amps., 1,300 R.P.M., complete with starter and regulator.—2200, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ONE 200-KW. Steam Generating Set for immediate sale, Willans-Mather & Platt, 220 or 440 volts. Perfect working condition.—JENNINGS, West Walls, Newcastle-on-Tyne. 1513

PETROL Set, 70 v., 80 a., Crypto; Motor-Generator, 220 v. to 70 v., 80 a.; ditto, 480 v. to 60 v., 80 a.; ditto, 440 v., 2-phase, 50 ~, to 100 v., 20 a.; ditto, 220 v., single-phase, 50/60 ~, to 60 v., 60 a.; ditto, 110 v., 60 ~, single-phase, to 85 v., 35 a.; ditto, 100/200 v., single-phase, to 70 v., 8/10 a. Several Gas and Oil Engines.—5241, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PLATING Dynamos, 50, 100, 200, 2500, 3600, 15,000 amp., immediate delivery.—5237, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REMINGTON Typewriter, brief, £14. Paraffin Vaporisers and Carburetters to 100 H.P. for converting gas engines, &c. State requirements. Gas Engines (Crossley), 6 H.P., 12 H.P., 14½ H.P., 25 H.P., 45 H.P.; Tangye, 50 H.P. Cheap.—Write, 4093, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ROTARY Converter, 5 KW., 440 volt, D.C.; 295 volt, A.C. Single-phase, 1350 revs. Perfect condition.—JAMES SIMMONDS AND CO., 1914, LTD., Newhampton Road, Wolverhampton. 2222

TELEPHONES. Several second-hand Magnetos, &c.—5159, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

THREE Igranic self-acting Starting Rheostats, for 500-volt D.C. Motors up to 10 H.P. Suit pumps, printing machines, lift compressors, &c. Condition perfect.—DRUMMOND & Co., Middlesbrough. 4842

THREE new 12-volt, 40-amp. Accumulator Sets in teak cases; high-class make, never been charged; pair would make excellent 25-volt lighting set; £4 12s. 6d. set. 8-volt ditto, £3 12s. 6d. Approval willingly.—105, Loyd Road, Northampton. 5211

THREE 8-H.P., 220-volt, brand new, shunt-protected Motors, 1600 revs.; just unpacked.—DRUMMOND & Co., Middlesbrough. 4839

TWO 250-KW. Belliss Alternator Sets, each comprising a Compound Enclosed Engine, with E.C.C. Alternator, 3000 volts, 50 periods; quite modern, and for immediate delivery.—HARRY H. GARDAM & Co., LTD., Staines. 1852

5-inch Gwynne Centrifugal Pump, direct coupled to 17-H.P., 460-volt, shunt Westinghouse Motor, with control panel, only used short while; condition perfect.—DRUMMOND & Co., Middlesbrough. 5189

15-H.P., 480-volt, series-wound Crane Motor, by Westinghouse; also one 16-H.P., totally enclosed, by B.T.H. Seen running.—DRUMMOND & Co., Middlesbrough. 4843

18-H.P., 440-volt, compound-wound, enclosed ventilated Motor, 1100 revs. Perfect order.—DRUMMOND & Co., Middlesbrough. 4841

44-KW., 110-volt D.C. Generator, compound wound, three-bearing type, with rope pulley and slide rails; speed, 600.—DRUMMOND & Co., Middlesbrough. 4895

70-VOLT, 300-amp. Bipolar, Compound-wound Dynamo, by Holmes; speed, 900; perfect order.—DRUMMOND & Co., Middlesbrough. 4893

110-VOLT, 75-amp. bi-polar Dynamo by Scott & Mountain. In perfect running order.—DRUMMOND & Co., Middlesbrough. 5216

175-H.P., 500-volt, 50-period, 290-R.P.M., 3-phase, slip-ring type Motor, with liquid starter. £420.—PHŒNIX, 32, Broomielaw, Glasgow. 2230

(Continued on next page.)

FOR SALE.—*Continued.*

300-KW., 230/250-volt, Steam Set; Howden engine, coupled to compound interpole generator. New 1910.—PHŒNIX, 32, Broomielaw, Glasgow. 2232

500-H.P., 440/500-volt, 150-R.P.M., compound interpole, four, bearing Motor, with rope pulley and elaborate control gear. Nearly new.—PHŒNIX, 32, Broomielaw, Glasgow. 2231

500-KW. Steam Generating Set, comprising a Belliss triple-expansion engine, coupled to an alternator by the Electric Construction Co., Wolverhampton, 3000 volts, 50 periods, with Wheeler-Worthington independent surface condensing plant; modern plant in first-class condition, and for immediate delivery.—HARRY H. GARDAM & Co., LTD., Staines. 1851

500-KW. Steam Set, comprising triple-expansion enclosed engine, coupled to Westinghouse multipolar generator, 440/490 volts, D.C. For prompt delivery.—HARRY H. GARDAM AND Co., LTD., Staines. 1413

ARTICLES WANTED.

HOUSE-LIGHTING SETS.

SMALL PETROL or Paraffin House-Lighting Sets wanted from ½ to 4 KW., new or second-hand; must be in good working order. Reply to—

OVERSEAS ENGINEERING CO., LTD.,
75, Curtain Road, London, E.C. 2. 2165

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ACCUMULATORS wanted for refining purposes. Obsolete Generating Sets, Dynamos, Motors, and all kinds of Machinery. Scrap Cable, Arc Lamps, Meters, Metal Residues, and Scrap Metals of every description purchased for prompt cash, town or country.—Apply A. BROWN & SONS, 142, Lower Clapton Road, London, N.E. Telephone: Dalston, 555. Telegrams: Secondhand, Lowclap, London. Established 1860. 4358

A.C. and D.C. Motors (second-hand), any type, any condition, wanted for prompt cash.—A. LEAROYD & SON, Bridge Works, Heatherley Street, Clapton, N.E. 4765

A LEAROYD & SON, Bridge Works, Clapton, N.E.—Telephone Dalston, 2278; Telegrams: Frangible, Lowclap, London—buys for prompt cash every description of second-hand Generating Sets, Accumulators, Motors, Transformers, old Arc Lamps, Meters, Cable, Scrap Metals, Metallic Drosses, &c., &c. Enquiries solicited. Established over 50 years. 4766

A 1 CASH Prices given for Electric Cable, Flexible Wire, Electrical Accessories, &c.—Apply DAVIS, 11, Sun Street, E.C. 2. 1424

A 4-H.P., 460-V., D.C. Motor, about 1000 R.P.M., wanted.—NORTHERN ELECTRICAL Co., Grimsby. 5144

ACCUMULATORS, one set for 100 volts, suitable for 100 20-watt lamps, second-hand or new.—5166, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ALL for Munition purposes.—Obsolete Motors, Dynamos, Insulated Cable, and every description of Electrical Plant bought to break up. Send us your stocks of scrap metals.—G. H. CHAPPELL SONS & Co., Midland Wharves, Lea Bridge Road, Leyton, N.E. 'Phone:—Walthamstow 500. Estab. 40 years. 4707

DYNAMOS, Motors, Arc Lamps, Meters, Scrap Cable, Iron, Metals or Machinery purchased for cash in any quantities.—J. HYAMS, 11, Glengall Terrace, Old Kent Road, S.E. Telephone: 3339 Hop. 5158

MOTOR, D.C. 5—6 H.P., 110 volts. 800—1000 R.P.M., complete, first-class condition.—RICHARDS, 9, High Street, Burton-on-Trent. 5228

OIL-driven Electric Light Plant wanted 100 or 50 volts with battery complete, about 200 to 300 ampere-hours capacity.—5169, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OLD Cable urgently required, also Lamp Tops.—WALLACE, Cromwell House, High Holborn. 4114

OLD Electric Lamps that have had wire-drawn tungsten filaments in them with glass parts intact, 1½d. each, any make.—101, Craven Park, London, N.W. 10. 5049

OLD Electric Lamps that have had wire-drawn tungsten filaments in them previously wanted, glass parts intact. Agent's price 2d. each.—847, Harrow Road, London, N.W. 10. 4932

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

PLATINUM Scrap purchased in large or small quantities. Highest market value given.—Before selling elsewhere call or post to the old and reliable firm, THE DEPÔT, 156, Charing Cross Road, London. Established 1850. 5199

ARTICLES WANTED.—*Continued.*

SECOND-HAND Motors, any condition, 5, 10 or 15 H.P., 400/440 volts, 50 cycles, 3-phase; particulars.—CORLETT Co., Wilcock Street, Wigan. 2244

STEEL Tubes, all sorts, wanted; Lampholders and Metal and Cardboard Shades; Gas Lighters, Static Electric; Screws, round head, and Hexagon Nuts.—DUGDILLS, Failsworth, Manchester. 5052

WANTED, a few 400-volt, 50-cycle, 3-phase Motors, preferably slip-ring type, 5 to 35 H.P.—8133, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a 400-KW. D.C., 500/550-volt, compound-wound Dynamo, without prime mover, for use on electric traction, and on electric lighting.—State speed, price, and where to be seen, to G. P. SHALLCROSS, Electrical Engineer's Office, Craven Street, Birkenhead. 2135

WANTED, Berry's Patent Transformer, 3-phase, 200-K.V.A. Primary 5,000 volts, periods 25, secondary 440 volts, amps. 262. Oil cooled.—5229, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, D.C. Motor-Generator, motor 220 volts, generator 70/100 volts, 150 amps.; urgent.—Box M 74, c/o Dawson's, 121, Cannon Street, E.C. 4. 5226

WANTED, for direct-coupling to high-speed steam engine, 500 revolutions, 30/40 KW. Generator, any standard voltage, but preferably 220 D.C.—Reply, stating maker, price and full details, to 1639, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, from 25 to 50-KW. Generator, 220 volts, compound wound, coupled direct to engine if possible or belt-driven. Steam pressure 100 lbs.—Apply EDWARDS, 36, Orleans Road, Twickenham. 5221

WANTED Immediately, Steam Engine and Dynamo, output about 15 kilowatts, 100 lbs. pressure, 100 to 250 volts.—Full particulars and price to BOOTH & BOMFORD, LTD., Electrical Engineers, 21, Castle Street, Cardiff. 5150

WANTED, Imperial Vacuum Cleaner for 100-volt circuit; shunt Dynamo, 70 v. 15-20 a.; Crawley Automatic Switch for 27 cells; small Accumulator Switchboard for 15 a. 50 v.—E. POWELL, Ltd., Tunbridge Wells. 5164

WANTED, modern shunt wound Motor, 9 or 10 H.P., 110 volts.—Full particulars, CORLETT Co., Wigan. 2201

WANTED, one compound high-speed vertical Steam Engine direct coupled to alternating current, three-phase Generator 50 cycles, 220 volt, and exclusive of exciter; engine to be suitable for steam pressure of 100 to 150 lb.; output required 120 to 130 KW.; set must be complete with all accessories, and absolutely first-class condition and make. State maker, date, and full particulars of plant, also price f.o.r.—2229, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED one 150-KW, Transformer, 5000/440 volts, 25 periods; must be in good condition.—Price and full particulars to THE MOSS GEAR Co., LTD., Thomas Street, Aston, Birmingham. 5198

WANTED, second-hand three-phase, 500-volt, 50-cycle wound Rotor Motor, 10/20 H.P.; preferably low speed and totally enclosed.—2206, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Set of 60/100 ampere-hour Accumulators for small electrical plant; also 20-amp., 60-v. Dynamo.—Reply to Box "A.C. 30," c/o Dawson's, 121, Cannon Street, London, E.C. 4. 5209

WANTED, several W.H. Meters, 500 volts direct current, 100 to 300 amps.—Write, with full particulars, to N., c/o Streets, 30, Cornhill, E.C. 3. 2220

WANTED, to hire or purchase, a few 200/220-volt, 50 or 70-cycle, single-phase Motors, with starting switches; sizes, 2 to 6 H.P.—Particulars to ENGINEER, Electricity Works, Redditch. 2120

WANTED, two A.C. Motors, 110 volts, 60 periodicity, 20/30 H.P., single phase.—Particulars to CRYSELCO LIMITED, Kempston Works, Bedford. 1826

WANTED, two Babcock & Wilcox water-tube Boilers, about 1000 sq. ft. heating surface each, 150 lb. working pressure, complete with fittings and mountings, preferably Hopkinson make; must be in first-class condition and available immediate delivery. Full particulars required, also price f.o.r.—2228, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, vertical compound high-speed Engine, 80/100 H.P., enclosed, self-lubricating type, by well-known maker preferred. Send price and full details, to 1638, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, 150-KW., 220-v. Generating Set: 30′ × 8′ Boiler 5-ton Travelling Crane, electric preferred; two 50-H.P., 220-volt Motors.—MARTINS, 320, Witton Road, Birmingham. 5103

WANTED, 220-volt, D.C., 25 and 30-H.P. Motors, 600 R.P.M.; 3-H.P., 1400 R.P.M. 440-volt, D.C., 7½-H.P., 1000 R.P.M.; 3-H.P., 1400 R.P.M.—WILLIAMSON, 104, Peckham Rye, S.E. 15. 5214

500-Volt Megger or Metrohm Set, good condition.—JAMES SIMMONDS & Co. (1914), Ltd., Newhampton Road, Wolverhampton. 2223

(Continued on next page.)

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Fig. 225

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97a, DALSTON LANE, LONDON, E.8.

Telegrams: "OCCLUDE KINLAND LONDON." Telephone: DALSTON 2365 and 2366.

OFFICIAL NOTICES.

Latest time for receiving 9.30 a.m. Thursday.

CITY OF LEEDS.

Electricity Department.

EXTENSIONS OF GENERATING PLANT.

THE LEEDS CORPORATION desire to contract for the purchase of the following:—

CONTRACT No. 1.—Extension to Feeder Switchgear in new works (three-phase).

CONTRACT No. 2.—Alteration of Generator Switchgear in old works (two-phase).

CONTRACT No. 3.—One Turbo-Alternator and Jet Condensing Plant, two-phase, 50 periods, 2,100 volts; capacity 6,000 kilowatts at .75 power factor; steam pressure 170 lbs. per sq. in.; vacuum 27½ in. with barometer at 30 in.; speed 1,500 revolutions per minute.

CONTRACT No. 4.—Two Water-Tube Boilers, Stokers, Economisers, Induced Draught Plants, Uptakes, Dust Catchers and Chimneys.

CONTRACT No. 5.—Coal and Ash Conveying Plant, Coal Shoots and Valves, and Ash Hopper Frames.

CONTRACT No. 6.—Steam, Feed, Water, Circulating Water and Blow Down Pipes, including erection, for new works.

CONTRACT No. 7.—Steam, Feed, Water, Circulating Water and other Pipes for old works (supplying materials only).

CONTRACT No. 8.—Large Centrifugal Pump, capacity 3,600,000 gallons per hour, or thereabouts, against a head of 33 feet, running at 235 revolutions per minute.

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Makers who are willing to tender for one or more complete contracts, and able to guarantee completion and erection within twelve months under P.4 Certificate, are requested to submt to me their names and the names of their sub-contractors (if any) by SATURDAY, AUGUST 10th, 1918.

C. NELSON HEFFORD,
Manager.

1, Whitehall Road, Leeds.
31st July, 1918. 2207

The MOLLER Patent Dust-Proof AIR FILTERS.
See Advertisement July 19th.
FILM COOLING TOWERS, LTD., 124, Chancery Lane, London, W.C. 2

EDUCATIONAL NOTICES.

Latest time for receiving, 9.30 a.m. Thursday.

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NOTICES RELATING TO PATENTS.

Latest time for receiving 9.30 a.m. Thursday.

John E. Raworth,
Queen Anne's Chambers, 28, The Broadway, Westminster, S.W.1. Chartered Patent Agent.

ADVERTISER desires to get into touch with a Firm of Manufacturing Electrical Engineers, with a view to the purchase of or working of his Patent for recording and indicating at any distance electrically the speed of engines, shafting, &c.—5190, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

THE Owner of Patent No. 115,973 invites correspondence from those interested with a view to the sale of rights.—5152, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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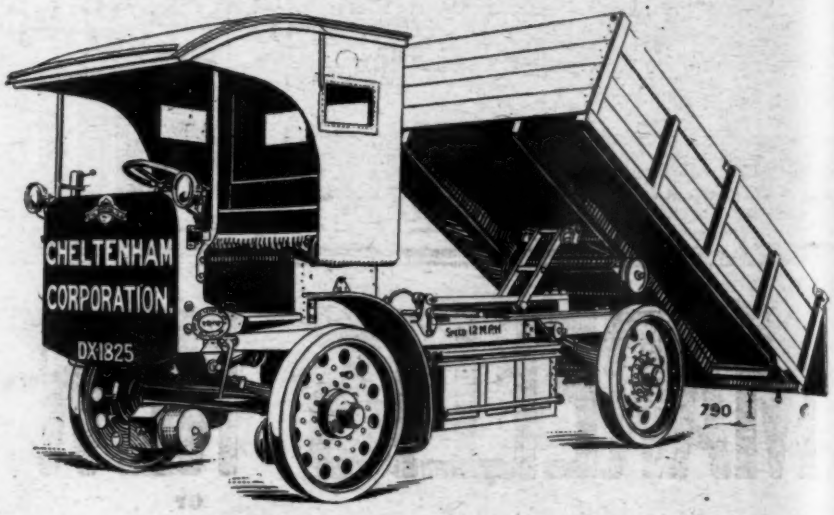

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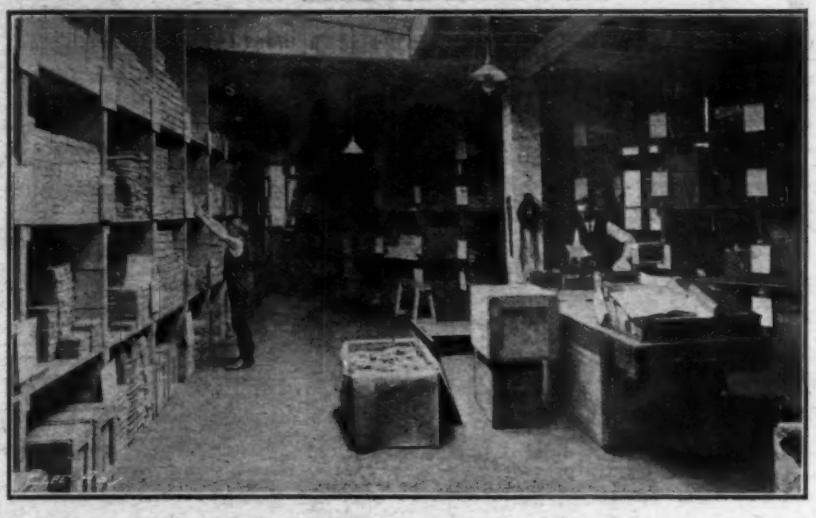

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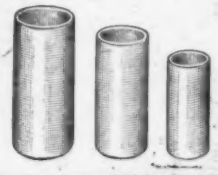

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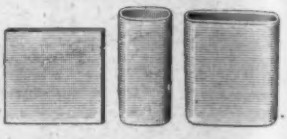

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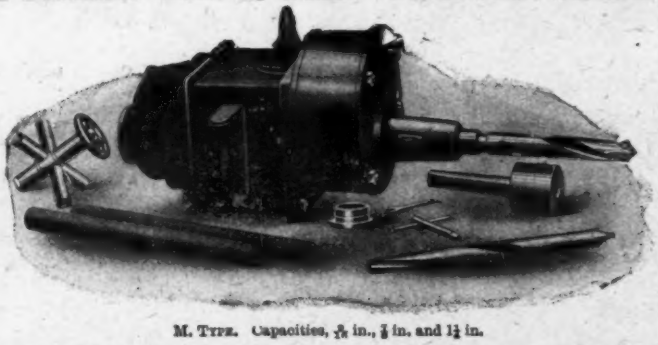

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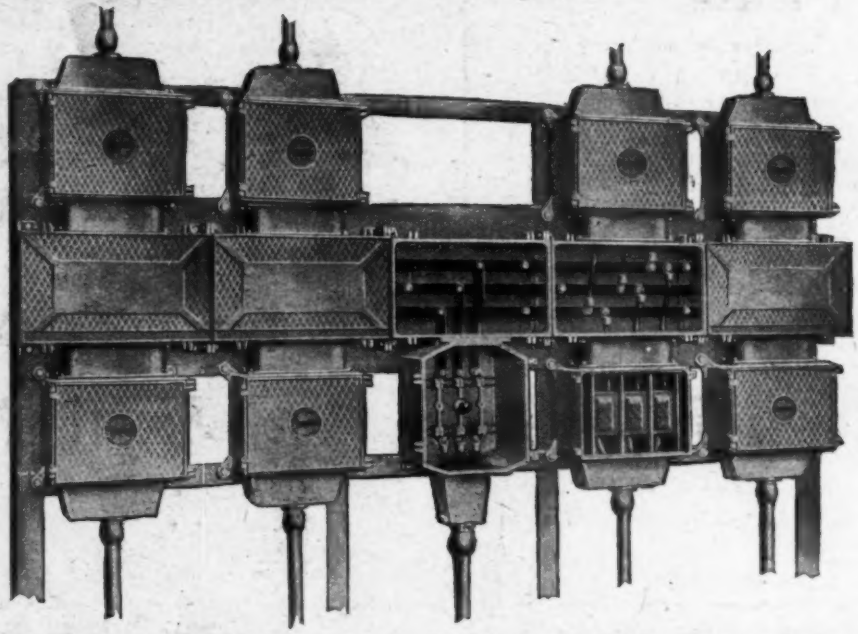

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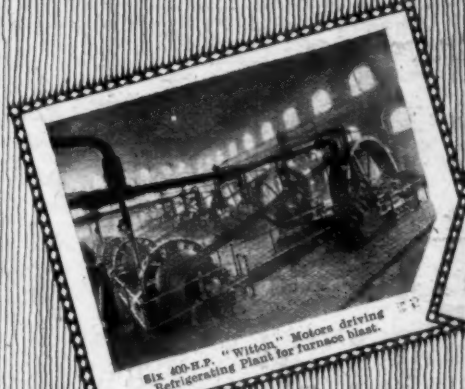

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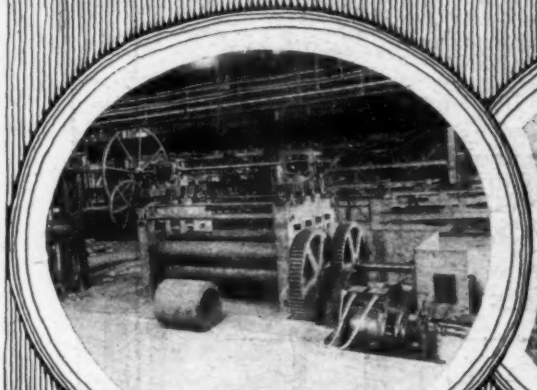

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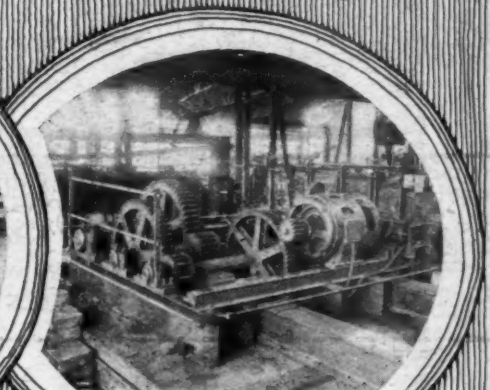

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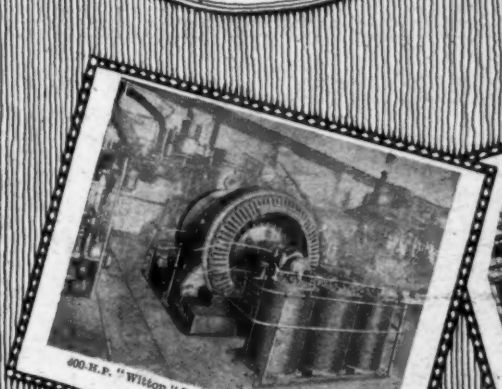

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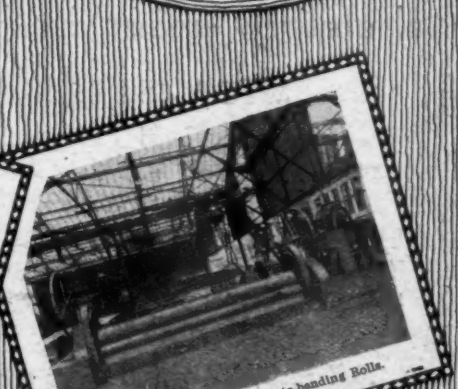

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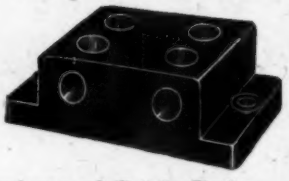

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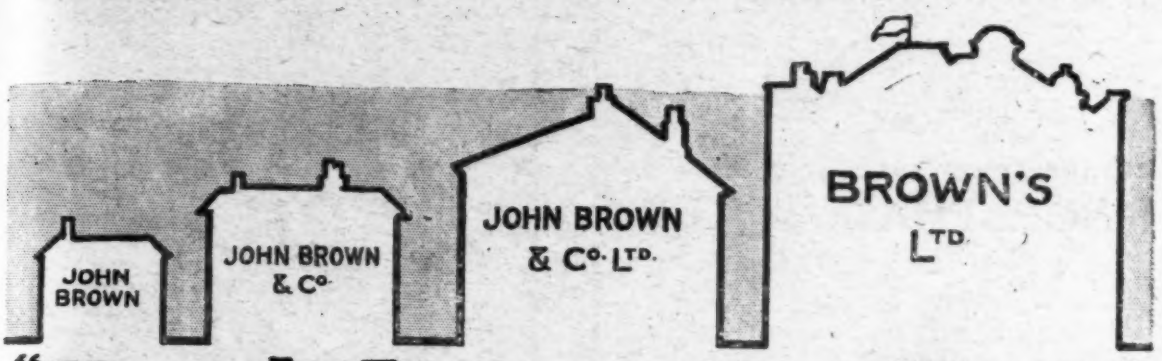

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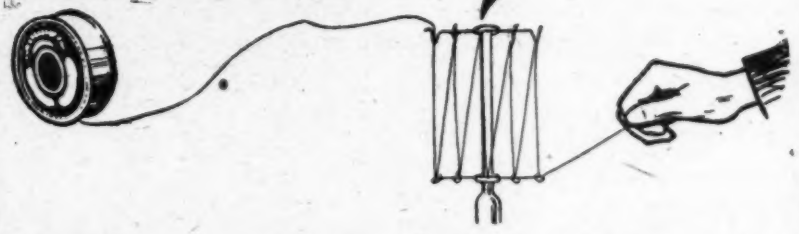

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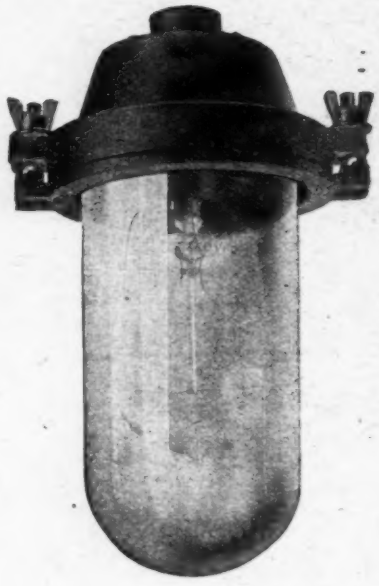

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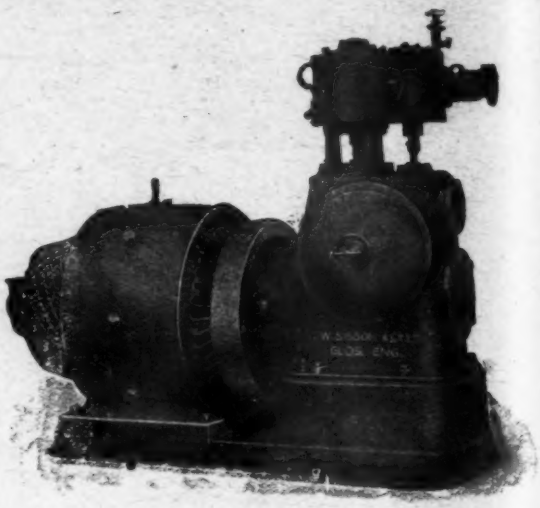

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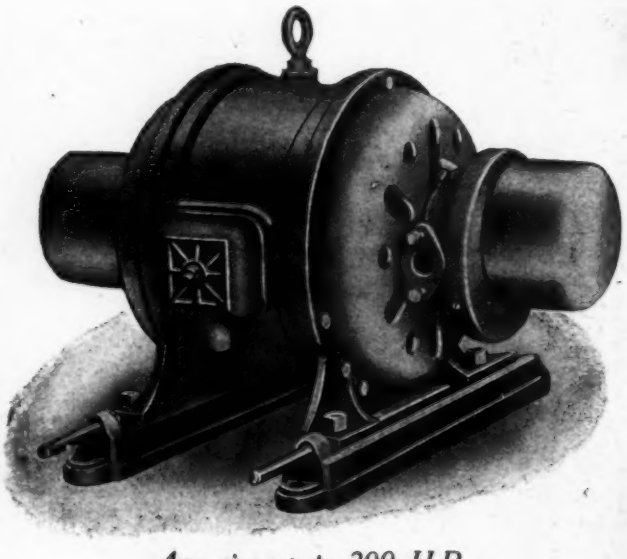

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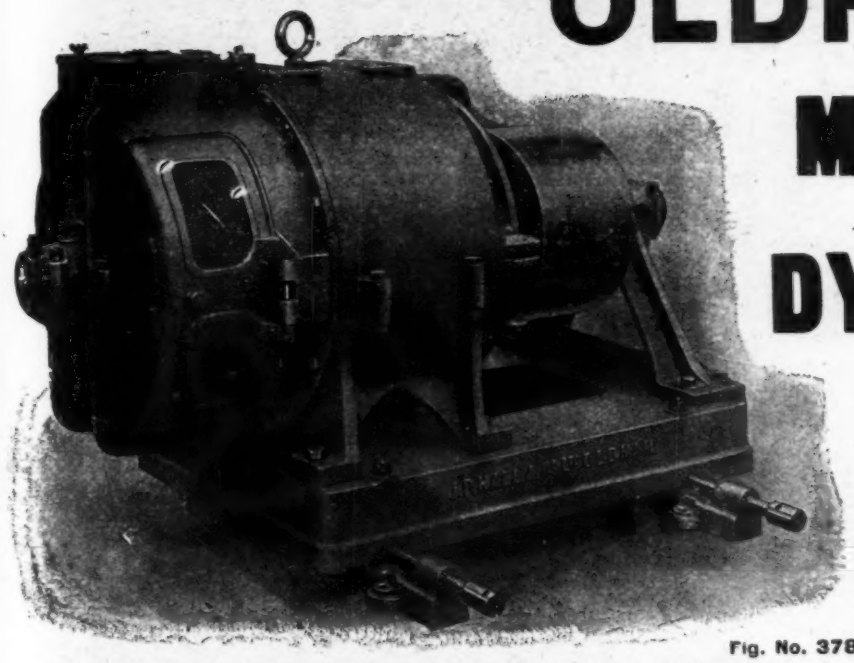
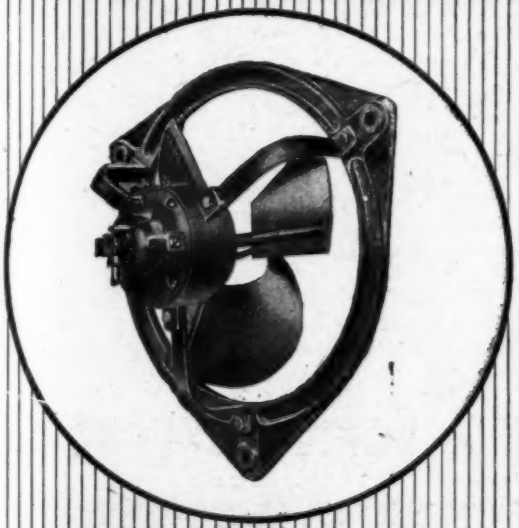


Fig. No. 378.
50-H.P. D.C. MOTOR WITH BEDPLATE AND OUTER BEARING.

MOTORS AND DYNAMOS FOR Direct or Alternating Current.

♦♦♦♦♦♦♦♦♦♦

EXHAUST



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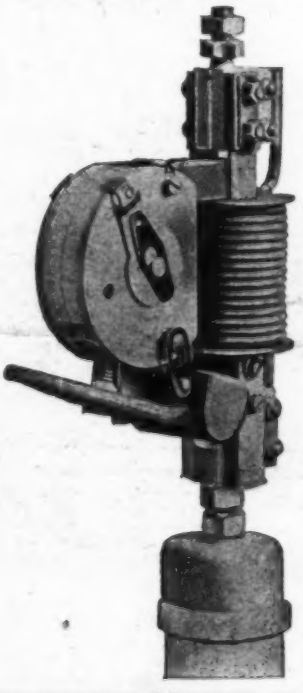
& Co LTD.
26–30 ARTILLERY LANE.
LONDON. E.C. 2.



BROWN-BOVERI TIME LIMIT OVERLOAD RELAYS, TYPE H.

Time of Trip is independent of Load current. No Series Transformer Required. Over 2,000 in use.

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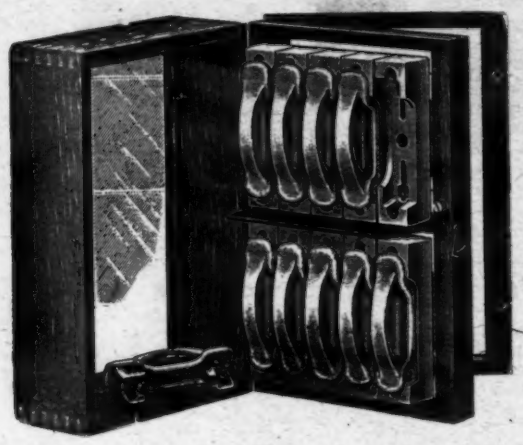

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We make several different patterns of Fuseboards. The "H.O." range illustrated comply with the Regulations of the Home Office. Accidental contact with live metal is impossible. The Board illustrated is mounted in a teak case fitted with a "swing back" attachment, which facilitates erection of the Boards and allows of easy and immediate access to the connections at any future time . . . . . We make "H.O." pattern Boards for

All Standard Capacities.
Voltages up to 500 Volts.

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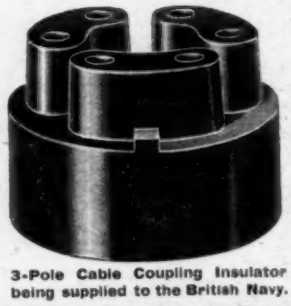

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HIGH ELECTRICAL RESISTANCE,
13,000 Volts per Millimetre.

Does not soften under any heat.

Moulded readily during manufacture into any shape.
Moulded on iron pins and into caps, etc.
Can be applied to metal parts.

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DOES NOT SOFTEN OR WARP.

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of the general district rate account. During the year the number of private consumers increased from 1,982 to 2,114. The total cost per unit sold was 3·28d., compared with 3·60d.

Leeds.—Price Increase.—The Electricity Committee has decided to increase the price of electricity to all consumers by 40 per cent. from October 1st, in place of the present increase of 20 per cent.

Lincoln.—Loan for Extensions.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £250,000 for the acquisition and extension of Messrs. Clayton & Shuttleworth's power station, and the supply therefrom to the works of Ruston, Proctor & Co., as recommended by Sir John Snell.

Llandudno.—Price Increase.—The T.C. has decided to increase the price of electricity by 1½d. per unit, making a flat rate of 7½d. per unit.

London.—Westminster.—Public Lighting.—With a view to decreasing the public lighting of its area, the City Council has provisionally agreed with the Charing Cross, West End, and City E.S. Co. for the replacement of the arc lamps at present in use by 100-watt incandescent lamps of the half-watt type. The cost is to be reduced by £5 per lamp per annum.

Lambeth.—Public Lighting Charges.—The B.C. has rejected a recommendation of the General Purposes Committee that the Electric Supply Corporation be allowed to increase the price of electricity for public lighting from 6d to 7d. per unit.

The B.C. has come to the conclusion that it would be inadvisable to reduce the street lighting in the inner part of its borough to more than 30 per cent. of the pre-war lighting, owing to the wide spaces between the lamps and the density of population, but in the outer area every effort is to be made to further reduce the lighting 50 per cent.

Street Lighting.—The Chief Commissioner of Police has addressed a letter to the Metropolitan Borough Councils stating that, with a view to securing further economy in the consumption of coal, the competent authorities have agreed that street lighting in inner London may be reduced to 50 per cent. of the pre-war lighting, provided that the reduction is spread equally over both main and side streets. The lighting of street lamps might be commenced later, and the extinction earlier than at present, provided that the majority of the lamps in the more important streets are lighted between one hour after sunset and two hours before sunrise during the summer period. This measure must be regarded as subject to revision, should the reduced lighting lead to any increase of crime or danger to traffic, or seriously handicap the supervision of the streets by the police. In any event, the matter would have to be re-considered at the expiration of the summer time. It was not desirable that any lamps now lighted should be dismantled. As special importance was attached by the military authorities to a uniform lighting effect, it might be necessary to make local alterations in the street lighting, to treat lamps of high power specially, and to increase lighting in places where the prevailing conditions demand this course.

Mansfield.—Year's Working.—There was a net loss of £162 on the past year's working of the T.C. electricity undertaking, compared with a net profit of £1,664 in the preceding year.

Meltham.—Prov. Order.—The U.D.C. has deferred consideration of an application from the Electrical Distribution of Yorkshire, Ltd., asking for the Council's support to the intended application to the B. of T. for a prov. order for the supply of electricity in the district.

Nelson.—Price Increase.—The Electricity Committee has decided to increase the charges for electricity by ½d. per unit for lighting and ¼d. for power.

Newquay.—Prov. Order.—The Bill confirming a provisional order of the B. of T. relative to the amendment of the Newquay E.L. Order has been passed by the Select Committee of the House of Lords on Unopposed Bills.

Rochdale.—Price Increase.—The Electricity Committee has recommended the following increases in the charges for electricity:—1/10 of 1d. per unit on power supplies under 15 kw. demand, and 5 per cent. for lighting, making a total of 55 per cent. over pre-war rates. The maximum charge will be 8d. per unit.

Scarborough.—Public Lighting.—The Corporation has deferred consideration of the question of public lighting by electricity, and has instructed the town clerk and engineer to interview the E.L. Co. and report further on the matter.

Stalybridge.—Loan Sanction.—The Joint Tramways and Electricity Board has received sanction of the L.G.B. to the borrowing of £8,000, for the laying of a main from the generating station to Hyde.

Stoke-on-Trent.—Price Increase.—The Council has approved the recommendation of the Electricity Committe for a further advance of 15 per cent. on all electricity charges, making 75 per cent. in all.

United States.—The World's Largest Power Systems.—In view of the interconnections that have taken place during recent months, it is interesting to note that the West has again established a world's record in power service. Hitherto the Commonwealth Edison Co. of Chicago had surpassed any other system of power distribution when steam-generated power in addition to hydro-electric power was taken into consideration. To-day, however, the combined system in Central California, under one management, now overtops all other systems in the world.

Thus the combined output of the Pacific Gas and Electric Co., the Great Western Power Co., and the Sierra and San Francisco Power Co., now under one management, shows a total during 1917 of 1,500,408,765 kw.-hours, while the total output of the Commonwealth Edison Co. amounted to but 1,488,080,000 kw.-hours. The next largest systems in America are, in the order named, the Niagara Falls Power Co., the Southern California Edison Co. and its interconnections, the Ontario Power Co., and the Montana Power Co., with respective yearly outputs of 1,188,221,770 kw.-hours, 1,150,000,000 kw.-hours, 990,086,100 kw.-hours, 954,913,584 kw.-hours, and 947,732,014 kw.-hours.

To have reached the vast total of a billion and a half in kw.-hours consumption is indeed a record to be proud of, when we contemplate the vast industrial and agricultural activity that is as a consequence brought to life in one giant network of interconnection. And, finally, when we consider that the major portion of this work is derived from indestructible water powers in the mountains, once again the potential possibilities of the West when fully developed, representing 10 times the present development, are seen to be so great as to almost stagger the imagination.

While this vast region west of the Rocky Mountains has but one-sixteenth the population of the United States, already within its confines there has been developed one-third of the total hydro-electric power now in operation in the United States. Nearly a billion dollars is represented in invested capital. The average *per capita* consumption of electrical energy is five times that of the remaining portion of the country.

Great optimism is felt in the future power possibilities of the West, for within its confines is located over 70 per cent. of the possible water-power of the nation.—*Journal of Electricity.*

Willesden.—Bulk Supply.—The North Metropolitan E.P.S. Co. has returned to the Council the draft of the agreement for the supply of electricity in bulk, with amendments to which the Council is unable to agree. A Sub-Committee has now been formed to meet representatives of the company.

Year's Working.—The annual accounts of the U.D.C. electricity undertaking for the year ended March 31st, 1918, show a surplus of £1,201.

York.—B. of T. Order.—The Electricity and Tramways Committee is applying to the B. of T. for an Order extending for a further period of one year the time within which the Corporation is to lay mains for the purpose of electricity supply under the York E.L. (Extension) Order, 1914, and to purchase land under the York Corporation Act, 1914.

TRAMWAY AND RAILWAY NOTES.

Canada.—Strike.—3,500 employés of the Montreal Tramways Co., by a practically unanimous vote, have decided to strike for increased wages.—*The Times.*

Colne.—Fare Revision.—The Corporation has increased the 1d. tramway fares to 1½d., and all other fares by ½d. The 1½d. tickets will be issued in packets of six for 7½d., or twelve for 1s. 3d.

Continental.—Sweden.—Mr. A. Groothoff, in a lecture recently delivered before the Royal Institute of Engineers, Holland, gave an interesting description of the electrified railway line from the Kiruna iron mines in Sweden to the "Empire boundary." The line is 93 miles long. Single-phase current at 80,000 volts is transmitted from Porjus Falls to four transformer stations, of which the first is 87 miles and the last 160 miles distant from Porjus. The voltage is stepped down to 15,000, at which pressure power is supplied to the contactors. The freight locomotives weigh about 100 tons and the passenger locomotives 70 tons each. A normal freight train consists of two electric locomotives and 40 ore cars of 46 tons each, the total weight being from 2,000 to 2,100 tons. Normal speed for freight is 18½ miles per hour, the maximum speed being 31 miles per hour. The maximum speed for passenger trains is 62½ miles per hour. In the first year this road transported 1,104,000 tons of ore, which is barely one-third of its normal capacity. Despite this low traffic, it showed a saving over steam operation, due partly to the high price of coal. The continuation of the road southward to Svarton, on the Baltic coast, has been decided upon, and the cost of the extension, 143 miles long, has been estimated at about £1,760,000. With an annual ore transport of 3,000,000 tons, electric traction can compare favourably with steam traction when coal is about 28s. a ton. The power for the whole road is to come from Porjus.—*Railway Gazette.*

Germany.—In an article on "Improvements in the Permanent Way of Tramways," in the *Organ für die Fortschritte des Eisenbahnwesens* of March 15th, the author discusses the best methods of rendering the tramrails stiffer, and remarks that welding the joints renders the metal softer. The new type of fish-plate made by the Georgs-Marien Mining Co., of Osnabrück, is illustrated and described. It consists of a pair of very long plates with eight bolts and a packing piece to support the joint itself, but even this is not so strong as the rail itself. The "Ibeco" type has plates which pass round the bottom of the rail as well as up the sides. He then discusses the corrugation of the rails caused by rapid traffic, but states that the cause is still doubtful. A recent type of

construction consists of a very shallow rail bedded on asphalt and resting upon reinforced concrete. One tram-rail is figured in which the web has longitudinal corrugations intended to give elasticity. Other illustrations, which are fully described, show the concrete foundation below the rail joint strongly reinforced.

Croydon.—YEAR'S WORKING.—There was a surplus on the past year's working of the B.C. tramway undertaking of £11,220, compared with a deficiency of £1,634 in the previous year. Traffic receipts increased by £20,947, and the total was £109,543. Working expenses amounted to £78,626.

The petition of the tramway employés that the £1 war bonus award of the Committee on Production to all licensed vehicle workers should be granted them, has been refused.

It is stated that season tickets are in contemplation for the tramways.

Edge Hill.—PROPOSED LIGHT RAILWAY.—The Light Railway Commissioners have submitted to the B. of T. for confirmation, an order for the construction of light railways in the Edge Hill district.

Ilford.—WOMEN DRIVERS.—It was stated at the Council last week that licences for women tramcar drivers would not be granted if discharged soldiers were available.

Lanarkshire.—STRIKE.—Women employed by the tramway company left work on Monday because they did not get an advance of 5s. weekly with the men.

London.—An experiment is being made on some L.C.C. tramcars with bags for the collection of old tickets. Some cars are being converted into goods trucks.

L.C.C.—EXTENSIONS.—For some time past the Highways Committee has been in negotiation with the M.E.T., Ltd., with a view to the institution of through-running arrangements between the Council's tramways and those of the company at Stamford Hill. Owing to the difficulties of equipment and maintenance the company is unable at present to undertake the operation of additional through-running services, *via* Stamford Hill, but an arrangement has been provisionally agreed to on the basis of the extension of certain of the Council's services beyond Stamford Hill to Seven Sisters' Corner. An extension of the service to Waltham Cross, or intermediate points, is to be arranged as soon as the necessary cars are available.

L.U.T. BILL.—This Bill, which has now been passed by a Select Committee of the House of Commons, authorises the company as from six months after the termination of the war, to charge fares not exceeding 1d. per mile for ordinary passengers, and workmen's fares not exceeding 1d. for the first 3 miles and ½d. per mile beyond. It also contains a clause prescribing that the powers of compulsory purchase by local authorities shall be exercisable within six months after January 1st, 1950, and within six months of the expiration of every subsequent seven years.

Middlesbrough.—ARBITRATION.—The Bradford Corporation has given permission to its tramway manager to act on behalf of the Middlesbrough Corporation in an arbitration for the acquisition of the tramways in its area.

Preston.—FARE REVISION.—The Corporation has increased the tramway fares, as from August 1st, by ½d. on all tickets, excluding workmen's.

Rochdale.—PRICE INCREASE.—The Electricity Committee has recommended that the charges to the Tramway Committee be increased by a tenth of a penny per unit, making 1·45d. per unit. The price of energy in future is to be subject to the coal clause.

TELEGRAPH AND TELEPHONE NOTES.

A Telegraphic "Jubilee."—Fifty years ago (July 31st, 1868) the telegraph system in this country was taken over by the General Post Office, and since the transfer telegraphy, with the sister science of telephony, has become an inherent part of our business life. By a curious coincidence, the past month has also seen the transfer of the American telephone and telegraph systems to State control; whether the transfer will become permanent or not remains for the future to decide. During the past decade the progress of wireless telegraphy has been one of the most striking features of the scientific world, the range of transmission having extended from short distances to many thousands of miles. After the war further developments may be expected.

Argentina.—The Siemens-Schuckert Co., representing Telefunken, of Berlin, has applied for a concession to erect a high-power Telefunken station for international and commercial messages. Detailed plans are to be presented 12 months after the concession has been signed, *force majeure* due to the war excepted. The construction is to be commenced one month, and the station completed in two years, after the plans are approved, failing which the deposit of $10,000 in paper currency is to be forfeited.—*The Times.*

Proposed New Cable.—At a luncheon given in New York in honour of a party of Australian editors, the establishment of a new direct cable between Australia and the United States was urged by a special committee of prominent business and professional men.—*The Times.*

The Telephone Service.—The P.M.G. is appealing for girls to enter the telephone service, pointing out its advantages as affording a permanent appointment on Civil Service lines without a competitive examination, and good prospects of advancement. A girl aged 19 receives 30s. 6d. a week to commence with.

Wireless Telephony.—Wireless telephone trials with Spanish apparatus were recently carried out, says the report of the British Chamber of Commerce in Spain, between the steamships *Raimundo Lulio*, at Barcelona, and the *Rey Jaime I*, during the voyage of the latter between Barcelona and Palma, Majorca, a few hours after she left Barcelona. The voices of the captain and an officer of the *Rey Jaime I* were heard on board the *Raimundo Lulio* and at land stations in Barcelona, as well as on board the cruiser *Princesa de Asturias.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—September 4th. Victorian Railway Commissioners. 800 lighting transformers for signal system. A copy of the specification may be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence) in London.

Belfast.—August 16th. Corporation. Two 6,000-KW. turbo-alternators, &c.; one 500-KW. turbo-alternator, &c.; one 30-KW. balancer-booster; four 48,000-lb. per hour water-tube boilers; four fuel economisers, &c.; two steel chimneys, with fans, &c.; two electrically-driven boiler feed pumps, &c.; accumulators; three 500-KW., and five 1,000-KW. rotary converters, with transformers, &c.; two 250-K.V.A., two 350-K.V.A., and six 1,250-K.V.A. transformers. See "Official Notices" July 19th.

Leeds.—August 10th. Electricity Department. Extension to feeder switchgear; alteration of generator switchgear; one 6,000-KW. turbo-alternator and jet condensing plant; two water-tube boilers, stokers, economisers, &c.; coal and ash conveying plant; pipes, centrifugal pump, &c. See "Official Notices" July 19th.

Spain.—Tenders have recently been invited by the municipal authorities of Medina de Rioseco (Province of Valladolid) for the concession for the electric lighting of the town during a period of 12 years.

CLOSED.

Barrow.—T.C. In connection with the new extensions:—

Foundations.—Hydraulic Mining Cartridge Co., £280.
Steam and circulating water-pipes.—Babcock & Wilcox, Ltd., £881.
Hand-rails for foundations.—Babcock & Wilcox, Ltd., £22.
Ironwork for foundations.—Joseph Webb & Sons, Ltd., £110.
Air duct for alternator.—Jas. Howden & Co., Ltd., £52.
Feed pump.—Jas. Howden & Co., Ltd., £250.

Bradford.—Tramways Committee.

Gear wheel castings.—Edgar Allen & Co., Ltd., and Cammell, Laird and Co., Ltd.

Hammersmith.—Electricity Committee. Annual contracts:—

Engine oil.—Dick & Co., Ltd.; 4s. 6d. per gallon.
Coal.—Cory Bros. & Co., Ltd.; Abercrwyd coal, 25s. 9½d. per ton.

Ilford.—U.D.C. Mossay & Co., Ltd., at £1,122, for a 3½-ton Orwell electric vehicle. The amount mentioned is exclusive of unloading gear, which is to be fitted.

Lancaster.—The tender of Messrs. Bennis & Co., Ltd., for the supply of two sets of machine stokers (£360) has been accepted by the Council.

London.—L.C.C.—The Highways Committee has purchased about 2,800 tons of coal and 3,400 tons of coke, for use at Greenwich power station, at a cost of about £58,000, during the quarter ended June 30th, 1918.

Main Drainage Committee. Accepted tender:—Electric ventilating fan and motor (£64), Allday & Onions.

Redditch.—U.D.C.

One 2,000-KW., 3,000-K.V.A., turbo-alternator and condensing plant complete.—C. A. Parsons & Co., Ltd.
E.H.T. switchgear.—Ferguson, Pailin & Co.
Cooling tower.—Lancashire Water Cooler Co., Ltd.
Boiler, stoker, Green economiser, and induced-draught fan.—Babcock and Wilcox, Ltd.

South Africa.—JOHANNESBURG.—T.C.:—

Hubert Davies & Co.—10,000 electric lamps, £1,107; Griffin Engineering Co.—3,000 traction lamps, £390.

Stepney.—Electricity Committee:—

E. Foster & Co.—3,000 tons Howley Park D.S. nuts at 30s. 6d. per ton.

Tasmania.—Launceston City Council. Messrs. Hinman, Wright & Manser, at £12,167, for the construction of a flume along the South Esk river from the intake dam to the electric power station.—*Tenders.*

Walthamstow.—U.D.C. Vaughan Crane Co., Ltd. Electric hoist, at £116, for the electricity department.

Wolverhampton.—Electricity Committee. Expanded metal partitions to enclose E.H.T. apparatus, &c., £57, Messrs. Halls, Ltd. The Committee agreed to the additional payment of £77 to the Rees Roturbo Manufacturing Co., Ltd. (owing to the revision in labour rates) in respect of their contract for two motor-driven pumps for a cooling tower, and of £66 to the General Electric Co., Ltd., in respect of additional wages paid in connection with the contract for a 900-KW. rotary converter.

NOTES.

The A.I.E.E. Convention.—The thirty-fourth annual convention of the American Institute of Electrical Engineers was held in June in Atlantic City, this being the second annual convention held by the Institute since the advent of the U.S. in the war. Judging by the ambitious programme, and the keen attendance, the Institute has lost nothing of its ability to contribute to electrical science and progress, although more than 10 per cent. of its members are in national service. While it was not a war convention in the strict sense, the effect of the war made itself apparent in the programme of papers, and it is easy to understand why the efficient utilisation of power and materials, the use of automatic instead of manual methods of control, and so on, have been the themes of the majority of the papers. President E. W. Rice's address was a masterly review of the electrical engineering progress of the time, and he sounded the keynote of the situation when he stated that the engineer was the hope of the nation, not only now, when they were at war, but even more so in the future—in the days of reconstruction following peace.

The meeting was devoted largely to a discussion of the engineering problems confronting the central-station industry, since it is upon the solution of these problems that the adequate and continuous supply of power depends. The convention included six technical sessions, an informal reception and dance on the evening of the first day, and conferences of Institute officers and section and branch delegates.

British Scientific Products Exhibition.—As we have already announced, this exhibition, organised by the British Science Guild, will be open from August 12th to September 7th, 1918. It will show how, by the combination of science and industry, we have not only supplied ourselves with the materials which before the war were imported from enemy countries, but have in many cases far surpassed the German products, and have established many new manufactures on a firm and enduring basis in this country. Over 250 manufacturers will take part in the exhibition, and the Air Ministry and the Food Production Department will also make large displays. The chief purpose of the exhibition is to educate the public mind to the realisation of the *necessity* of scientific research to progress in industry, and to demonstrate the remarkable results which have been achieved by this means since the outbreak of war; once the lesson is learnt, we hope it will never be forgotten. One section will be devoted to electrical and electromagnetic appliances, and in the "Physical Appliances" section a variety of electrical heating and welding apparatus will be shown; other sections relate to chemical products and processes, optical apparatus, refractories and porcelain, and measuring instruments. The exhibition will be held at King's College, Strand, London, and will include short lectures and addresses. Similar exhibitions have been held in France and the United States with successful results. The organising secretary is Mr. F. S. Spiers, 82, Victoria Street, S.W. 1.

The Inch v. the Metric System.—According to the *Journal of Electricity*, the American Consul at Geneva reports that a Swiss purchaser of iron sheets desiring to purchase sheets 3, 5, and 7 mm. in thickness, was informed by a British manufacturer that it would be impossible to furnish sheets of the thickness given in millimetres, as these sheets were made according to fractions of an inch. Manufacturers will do well to take note of this item.

Appointments Vacant.—Assistant mains engineer (£6) for the St. Marylebone B.C. Electricity Supply Department; junior assistant engineers-in-charge (32s. 6d. + 20s. + 12½ per cent.) for the West Ham Corporation Electric Supply; shift engineer for the Urban Electric Supply Co.'s Works, Stamford; charge engineer (58s. + 12½ per cent.) for the City of Gloucester Electricity Works; junior switchboard attendant (29s. 6d. + 9s. + 12½ per cent.) for the Rhondda U.D.C. Electricity Department; charge engineer (52s. + 12½ per cent.) for Mexborough Electricity Department. See our advertisement pages to-day.

For Sale.—Wallasey Corporation electricity department invites offers for the following surplus plant:—One 500-KW. direct-coupled, triple-expansion generating set, two wooden water-cooling towers, three sets of condensing plant, and one Green economiser. See our advertisement pages to-day.

Imperial Mineral Resources Bureau.—At the Imperial War Conference last year it was agreed that it was desirable to take steps to set up an Imperial Mineral Resources Bureau, which should be charged with the duties of collecting information from the appropriate departments of the Governments concerned and from other sources, regarding the mineral resources and metal requirements of the Empire; and of advising from time to time what action, if any, might appear to be desirable to enable such resources to be developed and made available to meet the metal requirements of the Empire. Accordingly a Special Committee under the chairmanship of Sir Jas. Stevenson, Bart., was appointed to examine this proposal, and to report upon the duties and administrative responsibilities of the proposed Bureau. The Committee defined the duties of the Bureau as follows:—

(*a*) To collect, co-ordinate, and disseminate information as to resources, production, treatment, consumption, and requirements of every mineral and metal of economic value.
(*b*) To ascertain the scope of the existing agencies, with a view ultimately to avoid any unnecessary overlapping that may prevail.
(*c*) To devise means whereby existing agencies can, if necessary, be assisted and improved in the accomplishment of their respective tasks.
(*d*) To supplement those agencies, if necessary, in order to obtain any information not now collected which may be required for the purposes of the Bureau.
(*e*) To advise on the development of the mineral resources of the Empire or of particular parts thereof, in order that such resources may be made available for the purposes of Imperial defence or industry.

After consideration of the report of this Committee, the Government instructed the Minister of Reconstruction, in consultation with the Secretaries of State for the Colonies and India, to take the necessary action to give effect to the recommendations of the Imperial Conference and the findings of the Committee. Detailed proposals were accordingly submitted to the Dominion and Indian Governments, who nominated their representatives on the governing body of the Bureau, and the general scheme of the Bureau has now been finally ratified by the Imperial Conference. The Bureau will be incorporated by Royal Charter, and the governing body, which will be under the presidency of the Lord President of the Council, will consist of the following gentlemen:—

Sir Richard Redmayne, K.C.B. (chairman)
Nominated by the Canadian Government.—Dr. Willet G. Miller.
Nominated by the Government of the Commonwealth of Australia.—Mr. W. S. Robinson.
Nominated by the Government of New Zealand.—Mr. T. H. Hamer, of the High Commissioner's Office.
Nominated by the Union of South Africa.—Right Hon. W. P. Schreiner, C.M.G.
Nominated by the Government of Newfoundland.—Right Hon. Lord Morris, K.C.M.G.
Nominated by the Government of India.—Mr. R. D. Oldham, F.R.S.
Nominated by the Secretary of State for the Colonies.—Mr. J. W. Evans, D.Sc., LL.B.
Nominated by the Minister of Reconstruction (in consultation with the Institute of Mining and Metallurgy, the Institute of Metals, the Iron and Steel Institute, and the Institution of Mining Engineers).—Mr. W. Forster Brown, Mineral Adviser to H.M. Woods and Forests.
Prof. H. C. H. Carpenter, President of the Institute of Metals.
Dr. F. H. Hatch, Member of Mineral Resources Advisory Committee of the Imperial Institute.
Sir Lionel Phillips, Bart., lately Director of Mineral Resources Development Department, Ministry of Munitions.
Mr. Edgar Taylor, ex-President of the Institute of Mining and Metallurgy.
Mr. Wallace Thorneycroft, President of the Institution of Mining Engineers.

Mr. Arnold D. McNair has been appointed secretary, and all communications regarding the Bureau should be addressed to the Secretary, Imperial Mineral Resources Bureau, Holborn Viaduct Hotel, E.C.

Volunteer Notes.—London Army Troops Companies, Volunteer Engineers.—Headquarters: Balderton Street, Grosvenor Square, W. 1.

Corps Orders No. 31, by Lieut.-Colonel C. B. Clay, V.D., Commanding.
Saturday, August 3rd, to Sunday, August 11th.—Annual Camp at Esher, Surrey. Parade at Waterloo Station, opposite No. 10 Platform, at 2 p.m., on Saturday, August 3rd. Dress: F.M.O. Billets are provided at Sandown Park (Fire Station Entrance).

C. Higgins, *Capt.* R.E., *Adjutant.*

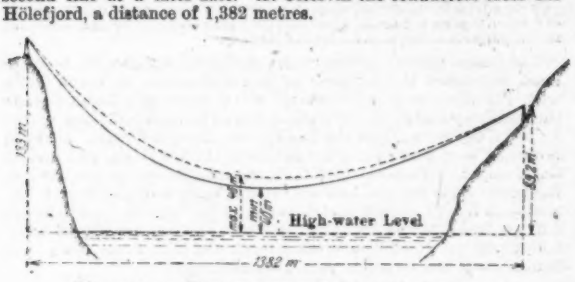
Welded Ships.—A special meeting of the Technical Committee of Lloyd's Register of Shipping has been held to consider the application of electric welding to shipbuilding to the extent of eliminating by this method the use of rivets for important structural connections. The Committee of Lloyd's has recently carried out a series of carefully devised experiments to determine, as far as can be done by means of tests and analysis, the general trustworthiness of structural connections effected by electric welding and their capacity to stand the strains to which they would be subjected in practice. The Technical Committee had before it a report from the society's chief ship surveyor on the results of these experiments, and to assist it in its deliberations, a demonstration was given at the society's offices. After careful consideration, the Technical Committee decided to recommend to the General Committee for approval certain recommendations put forward by the chief ship surveyor as to the conditions on which, as a tentative measure, welding might be adopted, instead of riveting in the construction of vessels intended for classification in Lloyd's Register Book.—*The Times.*

Electric Cooking and Heating.—From a letter which appears in our "Correspondence" columns it will be noted that Messrs. G. N. Haden & Sons repudiate that part of their Dublin circular which related to electric cooking, and express their entire agreement with the remarks of Mr. Hopkins, which we quoted, regarding the efficiency of electric cooking. We gladly welcome this statement of their views, and may add that we have reason to believe that the firm will shortly give a practical demonstration of their faith in the future of cooking by electricity. It may be of interest to add that the company was established over 100 years ago, and has, therefore, acquired a ripe experience in heating engineering.

The Flörli-Oltesvik Transmission Line in Norway.—According to the *Elektrotechnische Zeitschrift*, the city of Stavanger, Norway, has purchased various water-powers so as to assure its supply of electricity in the future. The total capacity of the water-powers held by the city will ultimately be about 200,000 KW., corresponding to 6 KW. per inhabitant. The city now owns one undertaking at Oltedal, near Hölefjord, and a second undertaking is in course of construction at Dorge, in Sirdalen. Great difficulties have been experienced in obtaining materials and machinery, and the scheme will, therefore, take longer to complete than was anticipated.

Under these circumstances the city of Stavanger has made an agreement whereby in the meantime about 4,000 K.V.A. will be purchased from the Flörli electro-smelting works at Lgsefjord. Later this supply will be increased to 11,000 K.V.A.

The energy will be carried from Flörli to Oltesvik along a transmission line 26·5 km. long, which is built for a pressure of 55,000 volts, but which will at first only be worked at 32,000 volts. For a distance of about 15 km. the transmission line traverses mountainous country (770 metres being the greatest height above sea level). It consists of a pole line carrying three copper conductors each of 50 sq. mm. cross-section, provision being made for a second line at a later date. At Oltesvik the conductors cross the Hölefjord, a distance of 1,382 metres.



NORWEGIAN TRANSMISSION LINE CROSSING THE HÖLEFJORD.

Twin wooden masts are used, the angle posts being made up of four wooden masts placed together. The lowest conductor is 7·5 metres above the ground, and the average length of span 131 metres. With the exception of the span which crosses the fjord, the length of the longest span is 250 metres. The conductors have a safety factor of 2·5, the wooden masts 7, and the iron masts 3.

The conductors which cross the fjord have a minimum height of 40 metres above high water, and ships with masts about 80 metres in height have sailed under the span on the Oltesvik side. These conductors spanning the fjord consist of 19-strand steel cable (with a fatigue rupture of 140 kg. /mm.^{2}) and with an outer cross-section of 16 mm. Each cable is carried on iron towers placed at distances of 15 metres apart, the conductors being 7 metres high. The safety factor of the steel conductors is 3, and that of the iron towers 4.

At Oltesvik the new transmission line will be linked up with the 30,000-volt line from Oltedal, and from that point onwards the existing Stavanger line will be made use of.

Development of the Electrical Industry in Italy.—The possibilities and impossibilities of industry in general in Italy have, says *Energia Elettrica*, been carefully worked out. Ten million tons of coal are needed for Italian industries to-day; to-morrow they will need other figures. Coal supplies will have to wait on imports; in other words, industrial activity will be at the mercy of the liberty of the seas and of the price of fuel. To overcome the difficulty resort is to be had to electricity. The lakes and rivers of the north and the midlands may give, it is estimated, about six million horse-power. Italian engineers think they may be able to yield more, and take their measures accordingly. Industrial and financial groups watch their operations attentively. It has been decided to electrify the Italian railway system, place electrical energy at the disposal of husbandry, and supply all branches of industry. Much is hoped from these great concentrations of industrial forces. We will merely consider the principal, indicating some of the largest undertakings. The Sindarco di Studi per Imprese Elettrometallurgiche Navali was constituted in Venice in February last, with the participation of the Adriatica di Elettricità, the Veneta per Costruzioni ed Esercizi di Ferrovie Secondari, and the Italiana per l'Utillizazione delle Forze Idrauliche del Veneto. This syndicate or trust has a vast programme, and contemplates utilising electric power for shipwrights' yards, foundries, and metal works on the Adriatic and at Venice. The Forze Idrauliche del Veneto Co. has raised its capital from 15,000,000 to 24,000,000 lire. The Forza Motrice dell 'Anza obtains 8,000 H.P. from the Anza River, and will feed a huge network of electric lines in the Province of Novara. It has absorbed the Dinamo Co., which possesses a large hydro-electric station at Varzo, supplied by the Rivers Diveria and Lairasca. The power obtained, about 20,000 H.P., is supplied to important companies, and especially for traction purposes, to the Vares Railway. Each company has a capital of 6,000,000 lire; the new company which is the outcome of the amalgamation will dispose of a capital of 25,000,000 lire. The Società Adriatica di Elettricità has raised its capital to 60,000,000 lire, in order to effect the establishment of the new company, the Società Idroelettrica Veneta. The Società Anonima Elettrica Siderurgica, of Lodi, has increased its capital from 500,000 lire to 2,000,000 lire. The Società per le Forze Idrauliche Ulzo sull' Ada has enlarged its capital from 4,000,000 to 6,000,000 lire, in order to take over the Martesana di Distribuzione d'Energia Elettrica. Great shrewdness characterises the Trezza d'Adda; its former position was certainly not a very brilliant one. In 1914 it had debts amounting to over 1,000,000 lire, which were reduced to 600,000 lire in 1915 and to 347,000 lire in 1916; this burden offered no hindrance to its managers distributing a 20-lire dividend recently. The Società Forze Idrauliche del Montcenisio is at the present moment augmenting its capital from 6,000,000 to 10,000,000 lire. The Elettriche del Piemonte Orientale is in a satisfactory position.

A prosperous development marks the Imprese Elettrica Conti; its available balance on December 31st, 1916, rose to more than 3,000,000 lire. The Elettrica Bresciana is an example of the rapid unfolding of the Italian electric industry. Its capital of 4,000,000 lire in 1905 was raised to 12,500,000 lire in 1907, afterwards to 16,000,000 lire, and in 1910 to 20,000,000 lire, and to 25,000,000 in 1915; it cannot be said that these increases have reached their end, for it appears that the company's field of expansion will shortly call for other augmentations of capital. The Società Caziale di Elettricita forms an exception to the rule; it remains stationary. The Italiana Conduttori Elettrici has raised its capital from 100,000 to 3,500,000 lire; its speciality in electric conductors assures it, since the war, a brilliant future. The Nazionale per Imprese Elettriche, of Milan, is growing; as a consequence of the incorporation of the Società per lo Sviluppo delle Imprese Elettriche, this company has raised its capital from 10,000,000 to 12,000,000 lire. As to the Adriatica di Elettricità, it is laying itself out for great industrial and financial potentialities by the increase of its capital from 36,800,000 to 60,000,000 lire. The Società di Elettricità Alta Italia forms an important trust company. Its capital is 30,000,000 lire, and, with the controlled companies (Piemontese di Elettricità, Magna, Ceanisdhia, and Valle d'Aosta), disposes of a total output of 83,700 H.P. The Forze Idrauliche dell' Apennins Centrale is a small company whose development will be most rapid. With the Elettrica Riviera Ponente Ing. R. Negri are bound up the great schemes which have attracted the attention of the world to Italy's water resources. The projects which the Negri Co. has in hand are huge; to realise them it needs enormous capital; it has already enlarged its capital to 50,000,000 lire, and by its amalgamation with the Officine Elettriche Genovesi, it will dispose of a capital of 200,000,000 lire. Account should also be taken of the fact that when the Negri Co. increased its own capital, it acquired the major part of the shares of the Società per le Forze Idrauliche della Maira. All these operations had the support of the Banca Commerciale Italiana and the Banca Italiana di Sconto. The older industries also take their shares in these undertakings; thus the firm of Ansaldo has participated in the increase of the capital of the Negri. To give an idea of the programme of the trust, we may say that it aims to create a great electrochemical and metallurgical industry in Northern Italy, and to electrify the whole of the railways. The Maira Co. already works the Montcenisio line and the lines of the Giovi. The trials on the Turin-Pinerolo line have been satisfactory; other lines connect Asti, Alejandria and Genoa. All these lines bear witness to an unusual shrewdness of conception and a perfection of execution that bids defiance to impossibilities. Italy is on the road to a great development; what she has done for the future of the electric industry is a clear proof of this; with immense progammes she is boldly grappling with material difficulties and financial exigencies. It is in the same spirit that she takes in hand huge amalgamations for which enormous capital subscriptions are needed. Within a short while the electric concerns will have absorbed 1,000,000,000 lire; the results will not fall below the power available.

Electrified Wheat.—According to the Agricultural Correspondent of the *Daily Mail*, the coming harvest will prove whether the process of electrifying seeds, especially wheat, oats, and barley, will be a success or a failure.

The electrification consists of soaking the seed in a weak solution of common salt or calcium chloride, passing a comparatively small electric current through the seed in soak for a few hours, and then slowly drying it in a kiln. The system is the invention of Mr. H. E. Fry of Godmanstone, near Dorchester. At present over 2,000 acres are under treated seed, sown under precisely the same conditions as ordinary seed and side by side with it.

At Mr. Allan Sturdy's farm at Trigon, Wareham, electrified oats stand higher than untreated oats, the straw is stronger, the tillering and the size and weight of ear are considerably greater.

At Mr. Duke's farm at Puddletown the average height of treated Benefactor wheat is 45 in., of untreated 41 in., and there is more than a corresponding difference in the length and condition of the ear, though, curiously enough, a square yard cut from both portions weighed equally.

On Mr. Lovelace's farm at Piddlehinton the average lengths are 49 in. and 47 in., and cutting a square yard of each resulted in the treated crop weighing 7¼ lb. and the untreated 4¼ lb.

As far as one can judge at present, says the writer, the electrifying process will add from 2 to 3 sacks to the acre.

Edison-Swan Electric Co., Ltd.—In the Chancery Division, on Tuesday, Mr. Justice Astbury confirmed the reduction of capital of this company under a scheme of arrangement between the company and its debenture stockholders and its members.

Women Chemists.—In view of the increasing demand for women works' chemists, we understand that the Council of the Wigan Mining and Technical College has decided to make provision for their training. It is also stated that the Wigan Electro-Metallurgical Works, Ltd., will in the autumn require a number of trained women analysts.

Institution and Lecture Notes.—Institution of Electrical Engineers.—In view of the practical impossibility, while the war continues, of holding the A.M.I.E.E. examination and of candidates having the requisite time to prepare for or undergo examination, the Council of the Institution of Electrical Engineers has decided to suspend temporarily the Institution rules with regard to examinations. The greatest care will, nevertheless, be exercised by the Council to ensure that only candidates possessing the qualifications laid down in the Articles in respect of training and experience are admitted to associate membership. Candidates who have been informed that they have been approved for associate membership subject to their passing the examination and who desire their applications to be reconsidered by the Council, are requested to communicate with the Secretary, at No. 1, Albermarle Street, W. 1.

Electrical Association of Australia (N.S.W. Section).—The Association, on April 12th, held a joint meeting with the British Medical Association and the Dental Association; papers were presented by Prof. O. U. Vonwiller on "The Theory of Electrolytic Conduction," and by Messrs. R. Grant (Board of Health) and Mr. W. H. Myers on "Some Practical Points in Ionic Medication."

Electrical Power Engineers' Association.—A meeting of the National Executive Council of the Association was held at Manchester, on July 27th. There were present, representing the Northern Division, Messrs. Annett, Atkinson, Spurr, Lunn, and Thomas; North-Eastern Division, Messrs. Porter and Vernier; Midland Division, Messrs. Mason, Bowser, and Burgess; Southern Division, Messrs. Bostel, Healy, Christmas, and Law. There were also present Mr. G. G. Bell (A.M.E.E., Greater London); Messrs. Parker and Young (C.T.A.A.); and Mr. W. A. Jones (hon. sec. of the E.P.E.A.). Mr. C. H. Wordingham (president I.E.E.) attended the meeting in an advisory capacity.

Mr. Lunn was elected chairman of the meeting.

The hon. sec. reported that as a result of a ballot of members there was a large majority in favour of proportional representation on the National Executive Council. The drafts of rules were considered, and a final draft was agreed upon, subject to legal approval and that of the Registrar before final submission to the members.

The development in connection with the A.M.E.E. and C.T.A.A. since the last meeting was reported upon, and after discussion it was unanimously agreed that it was necessary to safeguard representation of the various grades, namely :—

1. Chief engineers.
2. Departmental chiefs; and
3. The remaining members—on the Sectional and Divisional Committees and National Executive Council.

The following scheme was adopted for the basis of representation :—

10	per cent. to be elected by		Grade 1.
20	"	"	Grade 2.
70	"	"	Grade 3.

Provided that there should be not less than one representative of the three grades on any Committee.

The following officers were elected for the current year :—

President : Mr. A. L. Lunn.
Vice-Presidents : Messrs. R. C. Atkinson and H. Parker.
Treasurer : Mr. G. C. Law.
Hon. Sec. : Mr. W. Arthur Jones.

The thanks of the meeting were accorded to Mr. Wordingham for his attendance in Council.

The inaugural meeting of the Glasgow Branch of the Association took place last Wednesday in Glasgow. There was a large attendance, all sections being represented. The appointment of officials and a Provisional Committee took place. Mr. Holt, of Manchester, was present, and spoke of the rapid progress and excellent prospects of the branch. The Hon. Sec. is Mr. Arthur E. Kelly, 5, Battlefield Avenue, Langside, Glasgow, to whom all communications should be addressed.

Old Dry Cells.—Who that uses dry cells for bells, telephones, pocket lamps, &c., has not felt a twinge of conscience when scrapping worn-out batteries? An enormous amount of valuable material has thus been lost to the world, but fortunately this is no longer an inevitable waste. According to *Salvage*, old batteries need not now be classed among the "rubbish" of the sale yards. They are carefully and systematically "rendered to produce," and they furnish us with their own weight, less an average aggregate loss of weight of 6 per cent., of zinc, brass, pitch, graphite, manganese dioxide, white rags, and paper. The cost of the process, including all charges, is less than 20 per cent. of the value of the "produce" realised.

Late Legal.—Rio Tinto, Ltd., *v.* A.E.G. Electric Co., Ltd.—The Official Referee on Tuesday gave judgment in this case, deciding that the defendants had broken their contract by supplying a blower, the design of which was radically defective, and that the plaintiffs were entitled to damages, but not for loss of profit. The defendants were entitled to £1,757 on their counterclaim. The judgment will be reported in our next issue.

Carnival.—The employés of the Lydbrook Cable Works (H. W. Smith & Co., Ltd.) held a carnival on Saturday in aid of St. Dunstan's Hostel for Blind Soldiers and Sailors. The effort was highly successful, and the proceeds, amounting to £200, have been forwarded to Sir Arthur Pearson.

Municipal Tramways Conference.—Committees of the L.C.C. recommend the Council to send Messrs. A. H. Scott & W. J. Squires to represent it at the above Conference at Leicester in September on "the understanding that the Council is thereby in no way committed as to its policy with regard to matters discussed thereat."

Bosch Magneto Works at Stuttgart Bombed.—Our Independent Air Force visited Stuttgart on the night of July 30th—31st, and dropped nearly 2 tons of bombs on the Bosch Magneto Works, the Daimler Works, and the railway station.

Electro-Harmonic Society.—The annual meeting of this Society was held on Wednesday afternoon at the Institution of Electrical Engineers. The report shows that during the past season 31 new members were elected. There are now 594 names on the register, but this cannot be regarded as the number of effective members, as the rule under which names are removed cannot be applied as strictly as usual in view of the large number of members absent on active service. The arrangements for the 1918-19 season are as follows (all Friday evenings):—*Smoking Concerts* on October 11th and December 13th, 1918, and on January 10th and March 21st, 1919; Ladies' Nights, November 15th, 1918, and February 14th, 1919.

Lightning Accident.—A curious lightning accident is disclosed by Major A. Cooper-Key, H.M. Chief Inspector of Explosives, in his annual report just issued. An explosives factory in Kent was struck by lightning, with the result that one building was blown up and four others were set on fire at the same instant. A ton of nitro-cellulose dough digesting in alcohol, and contained in hermetically-closed iron drums, blew up, although, according to recognised principles, these "hollow conductors" should have been impervious to electric phenomena, and the solvent-impregnated dough should have represented a fire risk only, and should have been incapable of developing explosion. The factory was fitted with lightning conductors of the most modern type, in quite new condition, all light and power cables were well earthed, and the protection against lightning would seem to have been as good as could be devised.

The Skilled-Labour Embargo.—The names of the Committee of Inquiry that has been set up to investigate this subject are as follows :—

The Hon. Mr. Justice McCardie (chairman); Sir Stephenson Kent, K.C.B. (Ministry of Munitions); Sir David Shackleton, K.C.B. (Ministry of Labour); Sir Robert Horne, K.B.E. (Admiralty).

Sir Allan Smith, K.B.E.; Sir Herbert Rowell, K.B.E.; Mr. F. Dudley Docker, C.B.E. Nominated by the Engineering Employers Advisory Committee of the Ministry of Munitions.

Mr. J. Kaylor, Amalgamated Society of Engineers; Mr. G. Wilkinson, Amalgamated Society of General Toolmakers, Engineers, and Machinists; and Mr. W. F. Dawtry, Steam Engine Makers' Society. Nominated by Trade Union Advisory Committee of the Ministry of Munitions.

Mr. C. S. Hurst, secretary.

The terms of reference of the Committee are :—

1. To investigate and report on the labour conditions which have rendered the embargo necessary, and to advise upon the administration of the scheme.
2. To consider and report as to what further measures should be adopted, in view of those conditions, to maintain, and, where necessary, increase the output of munitions, due regard being given to the public interest in the most effective and economical use of labour, money, and material.

All communications should be addressed to the Secretary, at 6, Whitehall Gardens, London, S.W. 1. The first meeting of the Committee is to be held to-day to settle methods of procedure.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Permission has been granted to the Bradford Tramways manager (Mr. C. J. Spencer) to act on behalf of the Middlesbrough Corporation in the arbitration proceedings which are forthcoming for the acquisition of the tramways in its area.

Mr. C. J. Spencer, general manager of the Bradford Corporation Tramways, tendered his resignation on Monday last, consequent upon his having taken up an important position on the executive of the London Underground group of railways. He has been manager at Bradford for the past twenty years. He commenced his career with the Blackpool Electric Tramways Co., and was later given an appointment with the South Staffordshire Tramways Co. His services have been utilised by the Admiralty for over a year during the war. The Tramways Committee, in accepting the resignation, expressed its great regret at the loss of the services of Mr. Spencer. The resignation will take effect from November 1st.

The Highways Committee of the L.C.C. has authorised special duty payments in respect of extra services rendered during 1917 by the undermentioned officials in the tramways department, as follows:—Mr. E. L. Pope, £25; Mr. H. R. Saxby, Mr. G. T. Dickins, £50; Mr. J. Terry and Mr. E. Cloney, £30 each; Mr. H. R. Docker, £20; Mr. E. W. Dickinson, £50; Mr. J. R. Walker and Mr. H. Underwood, £20 each.

The Hammersmith B.C. Electricity Committee has appointed Mr. Duffy, of Wolverhampton, Temporary Engineer in charge at the generating station, at a salary of £175, plus a war bonus of £1 per week, plus 12½ per cent.

Mr. F. Golding, chief electrical engineer in the post and telegraph department at Victoria, has been appointed chief electrical engineer on the central staff of the Postmaster-General's department, at £900 a year.—*Australian Mining Standard.*

The marriage has taken place of Mr. Geo. Tatchell, assistant engineer at the Gravesend Electricity Works, and Miss G. E. Berrey, youngest daughter of Mr. J. Berrey, Mayor of the borough.

Roll of Honour.—Bombardier S. Sweeting, R.G.A., formerly an electrician at Wakefield with the Yorkshire Power Co., has been awarded the Military Medal for gallantry.

Lieut. Eric Bainbridge, R.F.C., reported dead after being missing since a patrol flight in September, 1916, when he was brought down in the enemy lines when attacked by six German machines, was prior to the war with Messrs. Crompton & Co., Ltd., of Chelmsford.

Mr. W. J. Head, of the India Rubber, Gutta Percha and Telegraph Works Co., Ltd., Newcastle-on-Tyne, has received news from the British Red Cross that his son, Private Lionel Head, R.A.M.C., who was reported missing on May 27th, is a prisoner in Germany, and well.

Sec.-Lieut. J. W. Parker, West Yorks Regiment, who was awarded the M.C., but did not live to receive it, was, before the war, with the General Electrical Supplies, Ltd.

Sapper A. E. Shuttleworth, R.E., who has died in hospital from pneumonia, aged 23 years, was an electrical engineer with Messrs. Simpson Bros., Hapton.

Private A. Jones, S. Lancashire Regiment, posted missing in August last, and now presumed killed, was an employé of the British Westinghouse Co., Ltd., Trafford Park.

Private T. Foley, Manchester Regiment, missing since last September, and now presumed killed, was employed by Messrs. Baxendale & Co., Ltd., Manchester.

Seaman W. Ruddock, who was employed at the Keighley Electricity Works, is reported drowned at sea on July 6.

Second-Lieutenant John Scott Youll, Northumberland Fusiliers, who was employed in the electrical department at the Thornley Colliery, Durham, has been awarded the Victoria Cross. Lieutenant Youll was formerly mentioned in despatches for services in France, and was on July 5th decorated by the King of Italy with the Italian Silver Medal for bravery.

Lieutenant F. C. Braby, Lancashire Fusiliers, son of Mr. Cyrus Braby, managing director of Messrs. Fredk. Braby and Co., Ltd., has received the Military Cross for conspicuous gallantry and devotion to duty during a determined enemy attack under intense machine-gun fire.

Two members of the staff of the heating department of Simplex Conduits, Ltd., have figured in recent honours lists, Sergeant-Major Surrall having been awarded a Meritorious Service Medal and Sergeant-Major Cutts a Distinguished Conduct Medal. Both of them voluntarily joined up early in the war.

Obituary.—Mr. H. C. Walsh, electrical engineer, Blackburn, died last week at the age of 44 years, from pneumonia following influenza.

Gauthier-Villars.—We recently recorded the death in action of M. Gauthier-Villars, captain of artillery, an officer of the Legion of Honour, and holder of the Croix de Guerre. From the *Revue Générale de l'Electricité* we learn that M. Gauthier-Villars was over military age when war broke out, but rejoined the Army as lieutenant of artillery in August, 1914, and at his own request was sent to the front as commandant of a train of heavy artillery, in which capacity he served up to the time of hs death. He was proprietor of *La Revue Électrique*, and when this well-known journal was combined with *La Lumière Electrique* he became a member of the administrative council of the *Revue Générale de l'Electricité*.

Will.—According to the *Times*, Major Austin Graham, Yorkshire Regiment, of Huntcliffe House, Saltburn-by-the-Sea, Yorkshire, electrical engineer, in business at Middlesbrough, who died from wounds on April 11th, left £5,025.

NEW COMPANIES REGISTERED.

Radio-Electric Clothing Co., Ltd. (151,007).—Private company. Registered July 20th. Capital, £10,000 in £1 shares (5,000 10 per cent. pref.). To carry on the business of manufacturers of and dealers in electrically-heated clothing, and all kinds of devices for lighting or heating by electricity, &c. The subscribers (each with five ord. shares) are:—Carl Magnus Holmquist, 4, Grange Road, Ealing, W., electrical engineer; James Guidici, 57, Uxbridge Road, Ealing Broadway, W., business manager. The first directors are to be appointed by the subscribers. Solicitor: L. C. Tree, 61, Carey Street, W.C.

Platit, Ltd. (151,024).—Private company. Registered July 23rd. Capital, £10,000 in 5,000 20 per cent. pref. shares of £1 each, and 100,000 ord. shares of 1s. each. To take over the business of chemical and electrical plating, and all other kinds of plating, carried on by Agnes Dalby at 137, Cheapside, E.C., as Dalby's Patents, with the patents granted in England, France, Russia, Japan, and the U.S.A., &c. The subscribers (each with one pref. share) are:—B. V. Clerke, F.A.A., &c., 63, Finsbury Pavement, E.C.2; J. Shepherd, Haslemere, Ranelagh Road, Wembley, Middlesex, accountant. The first directors are: E. R. N. Hyde, J. Lee, and Agnes Dalby (managing director). Registered office: 63, Finsbury Pavement, E.C.

Threadgill Electro Deposits, Ltd. (151,059).—Private company. Registered July 27th. Capital £5,000 in £1 shares. To take over the business of electro depositors and platers and metal workers carried on at Dudley Port, Tipton, as the Threadgill Electro Deposits Co. The subscribers (each with one share) are:—S. Threadgill, 5, Cannock Road, Falling Park, Wolverhampton, metal plater; J. B. Share, Shirley House, Bridgnorth Road, Wollaston, Stourbridge, engineer, &c. The first directors are to be appointed by the subscribers. Solicitor: J. A. Shephard, 2, Dudley Port, Tipton.

Belleek Felspar Co., Ltd. (150,053).—Private company. Registered July 27th. Capital, £2,000 in £1 shares. To acquire mines, &c., in Co. Fermanagh or elsewhere. Agreement with L. W. Carder. The subscribers (each with one ordinary share) are:—L. Shaffer, 20, Hawkshead Street, Southport, company director; W. Cooper, Hendre, Flixton, Lancs, cotton goods salesman. Governing directors: Louis Shaffer and Laurence W. Carder. Registered office: 24, Brazennose Street, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New Phonopore Telephone Co., Ltd.—Memorandum of satisfaction (a) in full on July 11th, 1918, of charge dated 1913, securing not more than £2,000, (b) on same date, to the extent of £1,233 6s. 8d., of charge dated 1910, securing £1,500, and (c) on July 15th, 1918, to the extent of £1,150, of charge dated January 27th, 1914, securing £1,250, have been filed.

Egham & Staines Electricity Co., Ltd.—Agreement dated July 1st, 1918, to issue £5,000 additional debs. ranking *pari passu* with existing debs., and extending time for repayment of and increasing rate of interest on the £12,000 existing debs.

Burnham & District Electric Supply Co., Ltd.—Debenture dated July 8th, 1918, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: T. G. Folliott and W. Moon.

Also registered:—Memorandum of satisfaction in full on July 8th, 1918, of debentures dated 1915 and 1917, securing £2,000, has been filed.

CITY NOTES.

French Companies.

The Société des Cables de Lyon reports the allocation of £12,000 to depreciation in 1917, leaving net profits and balance forward amounting to £26,000. It is proposed to pay a dividend of £2 per share.

The Société Electro-Métallurgique Francaise of Froges, after setting aside £149,000 for depreciation in 1917, states that the net profits amounted to £141,000 on a turnover of £1,174,000. It is intended to distribute £3 per share on the old capital of £620,000 and £1 8s. per share on the new capital of £380,000.

The Compagnie des Forges et Acieries Electriques Paul Girod of Ugine (Savoy), which is the French successor of the Swiss company of a similar name, reports having been occupied with war contracts during the first year's (1917) activity. The net profits reached £227,000, and a dividend at the rate of 20 per cent. has been declared on the Ordinary share capital of £600,000.

The directors of the *Compagnie Electro-Mecanique* report that new workshops had been constructed at Bourget and Lyons, and the production was largely increased in 1917. As net profits the accounts show the sum of £50,000, which permits of the distribution of £1 12s. per share or 8 per cent. on the old capital, and £1 3s. per share on the new shares.

The Société Westinghouse records net profits and balance forward amounting to £151,000 for 1917. The directors recommend a dividend at the rate of 2 per cent. on the ordinary shares. According to the annual report, the works at Havre were in full operation on the production of electrical and mechanical machinery for Government works or firms engaged on contracts for the national defence. A portion of the plant was also used for the manufacture of artillery undertaken by the company's subsidiary, the Société pour l'Exploitation des Procédés Westinghouse-Leblanc, and extensions of the works were being carried out as rapidly as possible on new sites adjoining the existing works.

The report of the *Ateliers de Constructions Electriques du Nord et de l'Est (Jeumont-Nord)* states that the company's works were still situated in the invaded districts in 1917, with which communication had become more difficult and uncertain. There was every reason, however, for fearing that most of the machinery and stocks had been removed from the works by the enemy. During the year the share capital was raised from £1,200,000 to £1,600,000. A works for the construction of electro-mechanical machinery had been established at Plaine-Saint-Denis, and the pre-war manufactures were being resumed. The order book was well supplied, but difficulties existed in obtaining materials, transport, and competent workmen. It was expected, however, that this works, which was far from being of the same size as the works at Jeumont, would yield satisfactory profits, and that it would allow the company to occupy a good position among electrical manufacturers on the conclusion of peace and pending the restoration of the Jeumont undertaking. The works at Saint-Ouen continued to work for the national defence, and afforded

favourable results. Concerning the companies in which the company is directly or indirectly interested, the directors mention that all the works of the Electricité et Gaz du Nord were occupied by the enemy. It appeared that the gas works had not been seriously damaged, and that this was the case also with the Jeumont central station, and the buildings at Maubeuge, where no machinery had been installed, were undamaged, but it was believed that a portion of the Lomme central station near Lille had disappeared. Under the circumstances it has been impossible to present any profit and loss account and balance sheet for 1917.

The report of the *Compagnie du Chemin de Fer Métropolitain de Paris*, whose financial results for 1917 were recently recorded in this column, deals with the customary great length with the movements during the year. The directors state that while the receipts experienced a further expansion owing to the growth of the traffic, the financial charges continued to rise, and in still greater proportions in consequence of the high price of coal and the dearness of labour and of raw and other materials for work of maintenance. Dealing with the first-mentioned, the directors state that the cost of coal before the war, which was obtained from the district of the Nord, was £1 per ton delivered at the works, including the city dues. Since then Cardiff coal had been used, and the cost delivered at the works amounted to £1 19s. 6d. in 1915, £2 11s. in 1916, and £3 19s. per ton in 1917, which prices were much lower than those paid by industrial consumers. The consumption of coal in 1913 was 150,000 tons for the production of 110,500,000 KW.-hours of three-phase current by the company's works and the Saint Denis section; 145,000 tons for 89,500,000 KW.-hours in 1915, 158,000 tons for 99,500,000 KW.-hours in 1916, and 153,000 tons for 97,000,000 KW.-hours in 1917, the proportion having varied with the efficiency or quality of the coal. The expenditure on coal in 1917 was £612,000, or £280,000 more than in 1916, and four times greater than in the pre-war period. The prices of materials for maintenance had risen a year ago from 300 to 500 per cent., and they continued to advance during 1917. The final result, as compared with 1916, was an additional outlay of £200,000 for coal, £100,000 for labour, and £40,000 for materials, whilst the City's share in the gross receipts rose by about £160,000. As a consequence, and notwithstanding an augmentation of £460,000 in the receipts in 1917, the net profits declined by about £40,000. The City of Paris, which granted the concession, was at the same time the company's joint partner, but only in regard to the receipts, not in the case of the expenses. The share of the City, which was £680,000 before the war, increased to £760,000 in 1916 and to £960,000 in 1917. The company had consequently asked permission either to advance the passenger fares or for the concession to be modified so as to reduce the City's share in the gross receipts. The Government authorities had already authorised increases in the case of provincial local railways and tramways, gas, electricity, and water works, Parliament had followed with similar sanction for the large railway companies, and at Paris the gas company had been empowered to raise its charges, and the directors believed that the Government would eventually not refuse to assist the company in endeavouring to re-establish the balance which affected the interests of no fewer than 25,000 shareholders.

Prospectus.—*The General Electric Co., Ltd.* In his speech delivered at the annual meeting in July, Mr. Hirst referred to the proposed increase of the capital to £3,000,000 by the creation of 100,000 additional preference shares of £10 each, and 60,000 additional ordinary shares of £10 each. He added that 80,000 and 16,000 of the latter were shortly to be issued to the public. The prospectus for the 6½ per cent. cumulative preference shares at par and for the ordinary at £13 has been before the public this week, the list opening on Tuesday. The purposes for which this new capital is required are: To complete the Fraser & Chalmers purchase (already referred to in these columns)—the price being between £500,000 and £600,000—and the provision of working capital to carry on the operations of that business; the repayment of bankers' advances; the further extension of the Witton engineering and carbon works; the completion of the G.E.C. Kingsway buildings; and the extension of the company's trade at home and abroad.

The financial papers state that the issue was largely oversubscribed on the opening day, and the lists were closed on that day except for applications arriving by Wednesday morning's post.

Stock Exchange Notice.—The undermentioned securities have been ordered to be quoted in the official list:—

British Insulated & Helsby Cables, Ltd.—500,000 additional ordinary shares of £1 each, fully-paid, Nos. 500,001 to 1,000,000.

Bristol Tramways and Carriage Co., Ltd.—Interim dividend for June half-year at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares.

Sao Paulo Tramway, Light, and Power Co.—Dividend of 2½ per cent., less tax.

Vickers, Ltd.—Interim dividend 1s. per ordinary share, free of tax up to 5s. in the pound.

City of Buenos Aires Tramways (1904), Ltd.—Dividend 1s. 3d. per share (at the rate of 5 per cent. per annum), less tax, for three months ended June.

Chelsea Electricity Supply Co., Ltd.—Interim dividend for the half-year at the rate of 3 per cent. per annum, less tax, on the ordinary shares.

Chatham and District Light Railways, Ltd.—Interim dividend for the half-year on the ordinary shares at the rate of 8 per cent. per annum, less tax.

Metropolitan Railway Co.—Interim dividend at the rate of 1 per cent. on the ordinary stock.

National Gas Engine Co., Ltd.—Interim dividend on the ordinary shares, 3¾ per cent.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—Interim dividend on the ordinary shares at the rate of 5 per cent. per annum.

Oldham, Ashton & Hyde Electric Tramways Co., Ltd.—Interim dividend at the rate of 5 per cent. per annum on the ordinary shares.

Stewarts and Lloyds, Ltd.—Interim dividends at the rate of 6 per cent. per annum on the preference, and 10 per cent. per annum on the preferred ordinary shares.

Yorkshire Electric Power Co.—Net profit for the half-year ended June, £23,683. The preference dividend is to be paid, but in view of the financial conditions arising out of the war the directors are deferring payment of a dividend on the ordinary shares until the accounts are made up for the year.

Westminster Electric Supply Corpn., Ltd.—Interim dividend at the rate of 7 per cent. per annum, less tax.

STOCKS AND SHARES.

Tuesday Evening.

Markets in most parts of the Stock Exchange continue to show activity and strength. There is a good deal of business going on. Considering the holiday season, the volume of trade is much larger than it usually is at this time of the year. Investment and speculation are both active. Contrasted with the corresponding week of four years ago, just prior to the outbreak of war, markets of to-day are cheerful and animated. Electricity supply shares stand below their pre-war levels, as do also nearly all the home railway stocks, but in other industrial lists, many of the pre-war prices have been left a long way behind, and amongst cable stocks and shares, for instance, the rises since July, 1914, have been substantial.

Four years ago, business during the last days of July was paralysed, and impending disaster, so soon to fall in the shape of a general outbreak of hostilities, hung like a pall over the Stock Exchange. Holders of even high-class securities found it practically impossible to realise them, for jobbers shut up their books, and refused to buy unless they knew where they could place what holders wished to sell, and the buyers of that time were few and far between. Since then, the open account, as it is termed, has been largely closed down, and the Stock Exchange of to-day occupies a firmer position financially than it has done for the last half-century. The anomaly is striking enough, and might be made the basis of a series of anomalies quite inappropriate to this column. Therefore, to descend:—

One feature of the past few days is another upward movement in the prices of the Underground Railways issues. Districts, Metropolitans, and the Underground Railways bonds and shares have hardened appreciably. The recovery in Underground Incomes is natural enough, but the rise in Metropolitans is less easy to understand. The return on the money at the present price is very inadequate, and though the company were to increase its dividend to 1½ per cent., the return would still be a small one. The advance in Districts is due to favourable reports with reference to the profits which the London General Omnibus Co. is declared to be making, added to which there is, of course, the probability that the recent rise in fares will make a substantial difference in receipts. It takes little buying to put up prices of these Underground stocks, but the converse is also the case, and when sellers come in, the market has a habit of moving down sharply.

Electricity supply shares remain as quiet as ever. The gas companies have recently secured an important modification from Parliament whereby the operation of the old sliding scale will be suspended and the companies enabled to increase the charges and dividends at the same time. Upon this, there occurred a brisk rally in the stocks of the principal companies, but this has had no effect upon those in the electric lighting group, which, of course, are not subject to the sliding scale arrangements, but which have a tendency to move in sympathy with gas stocks. The first of the interim dividends have been declared, but up to the present they have proved colourless, and there is nothing to shake the placidity of the market.

It is in the manufacturing group where most of the activity continues to prevail. Edisons have come along with a rush, animation being especially noticeable in the shares £3 paid. The price has jumped to 45s., the movement attracting a lot of speculative interest. British Westinghouse Preference and other similar shares keep good. General Electrics are not much affected by the issue of the prospectus offering new Preference and Ordinary shares, the latter at £13 per share. The prospectus states that the

directors hope to be able to allot one ordinary share for five preference shares applied for, and if this proves to be feasible in practice, the allottees will secure a cheap investment, the bonus on the ordinary shares being, of course, material, seeing that the existing ordinary stand at 28½. The issue has evoked considerable interest, and rumour is already busy with estimates of the proportion which applicants are likely to receive. The company's preference shares have fallen ½ to 10⅞. Babcock & Wilcox at 3 15/16 are 1/16 up, but no news has been published yet with reference to the expected bonus. Fraser & Chalmers have strengthened on the idea that the General Electric Co. may buy up all the shares, and at a higher price than that now current in the market.

Marconis have been active again, and the price of the parent shares rose to 4 on the eve of the meeting, at which it was expected that the chairman would make the important statement promised a week ago. Americans sympathised with a rise to 26s. 9d., but in the shares of the other subsidiaries there is not much doing. Anglo-American Telegraph stocks are better, and rises have occurred in Chile Telephones, Cuba, Globe Preference, United River Plates, and Westerns. The advance in the last-named puts the shares once more at the top of their particular group, so far as the quotation is concerned.

Rubber shares have hardened again. Advance (but not official) statistics have been received from the United States showing that the imports of rubber into America in June were almost up to the 25,000 tons to which the imports into the United States were supposed to be restricted for the whole of three months. The armament, iron, and steel groups are holding their prices with firmness, and quiet improvements have been secured during the past few days in the shares of the companies connected with tin and copper.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1916.	Dividend 1917.	Price July 30, 1918.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	9	10	6½	—	£7 13 10
Charing Cross Ordinary	5	4	3½	—	6 3 1
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	3	5	3½	—	7 13 10
City of London	8	8	11½	+ ¼	7 2 3
do. do. 6 per cent. Pref.	6	6	9⅛	—	6 0 4
County of London	7	7	10⅛	—	6 17 7
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	6	7	5½	—	6 13 4
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	4	5	3½	—	7 13 10
Metropolitan	8	4	3½	—	6 8 0
do. 4½ per cent. Pref.	4½	4½	3½	+ ¼	6 18 6
St. James' and Pall Mall	8	9	6½	— ¼	6 18 6
South London	5	5	3	—	6 13 4
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	9	6⅜	—	7 7 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	96	+1	6 5 0
do. Def.	1½	1½	29½	+ ½	6 13 4
Chile Telephone	8	8	9⅜	+ ⅛	4 4 3
Cuba Sub. Ord.	7	7	10	—	*7 0 0
Eastern Extension	8	8	15½	—	*5 3 3
Eastern Tel. Ord.	8	8	157½	—	*5 1 7
Globe Tel. and T. Ord.	7	7	14⅜	—	*4 17 5
do. do. Pref.	6	6	10	+ ⅛	6 0 0
Great Northern Tel.	24	22	87½	—	5 17 4
Indo-European	13	—	58½	—	5 11 1
Marconi	15	20	4	+ ⅛	5 0 0
Oriental Telephone Ord.	10	10	4½	—	2 2 2
United R. Plate Tel.	8	8	7⅛	+ 1/16	*5 6 8
West India and Panama	6d.	9d.	1/16	—	*3 6 8
Western Telegraph	8	8	16	+ ⅛	*5 0 0
Home Rails.					
entral London Ord. Assented	4	4	62½	—	6 8 0
Metropolitan	1	1	24	+ ½	4 3 4
do. District	Nil	Nil	21½	+2	Nil
Underground Electric Ordinary	Nil	Nil	9½	—	Nil
do. do. "A"	Nil	Nil	5/0	—	Nil
do. do. Income	6	4	84½	+1½	*4 14 8
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 6 4
Anglo-Arg. Trams. First Pref.	5½	5½	3⅛	+ 1/16	—
do. do. 2nd Pref.	5½	—	2½	—	—
do. do. 5 Deb.	5	5	65½	+ ½	7 12 8
Brazil Tractions	—	—	47	+3	—
Bombay Electric Pref.	6	6	9½	—	6 6 4
British Columbia Elec. Rly. Pfce.	5	5	61½	—	8 2 8
do. do. Preferred	Nil	Nil	45	—	Nil
do. do. Deferred	Nil	Nil	40½	—	Nil
do. do. Deb.	4½	4½	60½	—1	7 0 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	44½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	36½	—	Nil
Mexican Light Common	Nil	Nil	21	—	Nil
do. Pref.	Nil	Nil	39	+ 3	Nil
do. 1st Bonds	Nil	Nil	49	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3 15/16	+ 1/16	3 16 2
British Aluminium Ord.	10	10	1⅝	—	5 6 8
British Insulated Ord.	20	20	2	—	5 0 0
British Westinghouse Pref.	7½	7½	2⅞	—	5 19 6
Callenders	20	25	15½	—	6 11 7
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	20	5⅞	—	5 16 0
Edison-Swan, fully paid	—	—	3⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	75½	+1	5 6 0
Electric Construction	7½	10	1⅞	—	7 12 4
Gen. Elec. Pref.	6	6	10½	— ¼	6 5 4
do. Ord.	10	10	28½	—	*3 10 0
Henley	25	25	2½	—	5 17 8
do. 4½ Pref.	4½	4½	3⅜	—	5 12 2
India-Rubber	10	10	16½	—	*6 4 0
Telegraph Con.	20	20	44½	—	*5 7 8

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, July 31st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£80	..
a Ammonia, Muriate (large crystal)	"	£75	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£13	..
a Copper Sulphate	"	£65	..
a Potash, Chlorate	per lb.	2/6	..
a " Perchlorate	"	2/-	..
a Shellac	per cwt.	£17 5/-	..
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers	"	£35	..
a " Lump	"	£25	..
a Soda, Chlorate	per lb.	1/1	..
a " Crystals	per ton	170/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 3" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn)	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn)	"	1/8½ to 1/9	..
g " Bars (best selected)	per ton	£161	£14 inc.
g " Sheet	"	£161	£14 inc.
g " Rod	"	£161	£14 inc.
d " (Electrolytic) Bars	"	£137	..
d " " Sheets	"	£152	..
d " " Wire Rods	"	£145	..
d " " H.C. Wire	per lb.	1/6⅜	..
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/8	..
n German Silver Wire	"	2/6	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/-	1d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£37	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e " " " medium	"	8/6 to 6/-	..
e " " " large	"	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/6½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	5/-	6d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

The Nerve Record of an Air Raid.—How an air raid affected the nerves of a lady may be seen from a report made by Dr. A. D. Waller to the *Lancet*.

Dr. Waller describes interesting results obtained by studying what he calls the "emotive response" or "psychogalvanic reflex" on various individuals. The person experimented upon has the electric current from two battery cells sent through the thickness of the hand from back to palm, or *vice versâ*. Measurement of this current by means of a galvanometer shows that it varies with the emotional experiences of the subject. There is an "emotive response" not only to physical stimuli such as burning, unexpected noise, or smell, but also to mental stimuli such as apprehension, questions, and thoughts, pleasant or unpleasant :—

"From many experiments made on various subjects, besides the big variation in actual resistance, there is a marked difference in emotive response; also in the change of resistance which takes place during an experiment, and in the response of the subject to the same stimulus at different stages of the experiment. In some individuals a greater physiological change may be caused by an imaginary than by a real excitation. This is especially the case in imaginative subjects, such as members of the literary, artistic, and scientific professions. A very interesting record is given of the response of a subject taken during an air raid.

"It would be of extreme interest to know the nature of response in series of subjects who have successfully withstood many nerve-trying ordeals—as, for example, the fighting air-pilot. It is possible that this test would be of value in special cases in the selection of air-pilots, and also invaluable to the military authorities as an adjunct to the ordinary medical examination in classifying doubtful 'nerve' cases—*e.g.*, shell-shock, neurasthenia, and malingering."

German Electricity Works Association.—The annual meeting of the German Association of Central Electricity Stations was held recently in Berlin, when, among other business, reports were presented by Herr Spengel on "The Working of the Limitations on Electricity Consumption from the Technical and Economical Standpoints"; by Herr Coninx on "The Supply of Coal and Other Materials for Central Stations"; and by Herr Döpke on "The Existing Situation in Central-station Supply Work."

THE EDUCATION AND TRAINING OF ENGINEERING APPRENTICES.

By P. H. S. KEMPTON, A.R.C.Sc., B.Sc.

(Continued from page 76.)

For Naval Apprentices.

First year attendance	...	6 hours per week.
Second year attendance	...	7 hours per week.
Third year attendance	...	7 hours per week.
Fourth year attendance	...	4 hours per week.

First year Course.—Fitting and turning, engineering drawing.

Second year Course.—Fitting and turning, engineering drawing, algebra.

Third year Course.—Applied electricity, fitting and turning, applied mechanics.

Fourth year Course.—Applied mechanics, applied electricity.

Prizes are offered for special excellence, and nomination to studentship at the full-time courses at the college with rank as engineer-assistant falls to the best student in each final group of trades.

Failure to profit by the course, misconduct, or "neglect to make a proper effort" renders an apprentice liable to immediate determination of his services.

Abroad.

There is little doubt that the folly of a stubborn adherence to the "splendid isolation" theory has prevented the influx of many valuable ideas into the educational and industrial system of this country. We have only to remind ourselves of the industries which we have lost and are now feverishly striving to regain to see evidence of our refusal as a nation to assimilate successful foreign ideas in science and technology. We have invariably sneered at the idea of industrial research; now we are awakened to its necessity by the thundershock of war. We have hitherto hesitated to introduce systems of management and training into our industrial concerns because they hailed from the States or from Germany; now our alliance with the former and enmity to the latter have forced us to "do something" to bring our industrial organisation into line with that of our rivals. And in educational and technical matters we have been the victims of an obeseness of contentment which has been as insane as it has been unproductive.

In some recent articles in *Engineering*, now reprinted as a booklet entitled "The Training of our Industrial Forces," Mr. H. F. L. Orcutt has made a valiant attempt to rouse the nation to its post-war responsibilities. He says: "We are now faced with a struggle in trade as definite, as fierce, and as widespread as that with which we are now engaged in opposing with an army and navy. Is it not reasonable that we should seriously consider whether or not we are prepared to the last detail? It has been stated that we have every element necessary to success. In these is our man-power comparable with what it should be? This man-power cannot be effective without training, a training particularly arranged to meet new conditions of warfare.

"Our two great competing nations, America and Germany, have already made a beginning. They have not gone so far, however, but we can overtake them. They have gone far enough to demonstrate completely the lines which must be followed, the mistakes to avoid and the practical results which can be attained."

Mr. Orcutt's contention is a sound one, and his marshalling of the facts which ought to deeply concern all who are worthy of the name of Englishman is provocative of thought and action. Here we are concerned mainly with one branch of our industrial forces, and it is to the investigation of the methods of America and Germany in the training of apprentices that we devote the following paragraphs:—

U.S.A.

Under the title "Life in a large Manufacturing Plant: Apprenticeship System," there appears in the January issue of the *General Electric Review* an account of the training of boys by the G.E.C. in connection with their six American factories. The G.E.C. has spent $750,000 in buildings, machinery, instruments, class-rooms, and laboratory equipment for its apprentices' department. The boys are entered at 16, and their training proceeds in the class-room simultaneously with the workshop. The system is in fact a "works school" system, and for equipment and general organisation is probably the most complete of its kind in the world. The class-room courses include instruction in mathematics, including algebra, trigonometry, plane, solid, and descriptive geometry, mechanics, machine drawing and design, and extends over the whole apprenticeship period. In some courses the school instruction in work hours is as much as 10 hours in 50.

In addition to the school or class-room instruction, the company provides special training shops for the apprentices, where beginners are given individual instruction under competent men engaged for the purpose. As the students become more advanced they are transferred to the regular shops where their education is continued under the direction of the foreman of that department and his assistants. In December, 1917, the number of apprentices who were with the G.E.C. and consequently included in the training system was as follows:—

At Lynn, 335; Schenectady, 302; Pittsfield, 113; Erie, 85; Fort Wayne, 82; Harrisson, 20; totalling nearly 1,000 "electrical works undergraduates."

Considerable stress is laid on the social life of the boys, and in all the works one or more complete libraries are available for the apprentices. Opportunity for baseball and boating, football, skating, and skiing are open to all apprentices with athletic leanings; while in connection with most of the works are Y.M.C.A.'s, mutual benefit associations, musical organisations, amateur theatricals, all affording ample opportunities for social life among the young men. The G.E.C. claim that their system of training supersedes to some extent the *college* training. They quote a long list of inventors, scientists and engineers who were *not* college men, including Bessemer, Faraday, Singer, Huxley, Spencer, Edison and Nobel; and argue quite accurately that such a training as is given in the works teaches three important things which are not taught in college, viz., "the value of the dollar, the independence which comes from earning one's own living, and the strength of character developed by working with men."

Similar courses of apprentice instruction are followed in the works schools of the following American engineering companies: Western Electric Co., Westinghouse Electric and Manufacturing Co., Cadillac Motor Car Co., Ford Motor Co., and others.

The National Cash Register Co. have a unique system in which their apprentices attend the works and the works school on alternate weeks during the first two years of apprenticeship. At the end of this period the most proficient students are allowed to commence, at the company's expense, a five-years' course at the University of Cincinnati, in which they spend alternate fortnights at the works and the university. As an alternative to this system, the same company give some of their apprentices part-time day instruction at an outside school up to the age of 20, during which time school fees and wages are paid by the company.

The Pressed Steel Co. and the Cleveland Ironworks have works schools, but the classes are held immediately after and not during works hours.

(To be concluded).

TRADE STATISTICS OF JAPAN, 1916.

The following statement, showing the imports into and the exports from Japan of electrical and similar goods during the year 1916, is taken from the recently-issued official trade statistics; the figures for 1915 are given for purposes of comparison, and notes of any increases or decreases are added :—

IMPORTS.

	1915. Yen.	1916. Yen.	Inc. or dec. Yen.
Galvanised iron wire.—			
From Great Britain ...	146,000	367,000	+ 221,000
,, Germany	39,000	30,000	− 9,000
,, Belgium	—	4,000	+ 4,000
,, United States ...	2,969,000	3,797,000	+ 828,000
,, Other countries ...	21,000	126,000*	+ 105,000
Total	3,175,000	4,324,000	+ 1,149,000
* Canada, Yen 101,000.			
Posts and materials for electric lines.—			
From United States ...	2,000	4,000	+ 2,000
Copper (pipes and tubes).—			
From Great Britain ...	37,000	500	− 36,500
,, Other countries ...	1,000*	500	− 500
Total	38,000	1,000	− 37,000
* United States.			
Insulated electric wire.—			
From Great Britain ...	6,000	1,000	− 5,000
,, Germany	94,000	1,000	− 93,000
,, United States ...	13,000	21,000	+ 8,000
Total	113,000	23,000	− 90,000
Steam turbines.—			
From Great Britain ...	—	22,000	+ 22,000
,, United States ...	24,000	8,000	− 16,000
Total	24,000	30,000	+ 6,000
Cranes.—			
From Great Britain ...	20,000	—	− 20,000
,, United States ...	21,000	—	− 21,000
,, Sweden	—	50,000	+ 50,000
Total	41,000	50,000	+ 9,000
Pumps.—			
From Great Britain ...	182,000	93,000	− 89,000
,, Germany	9,000	—	− 9,000
,, United States ...	57,000	121,000	+ 64,000
,, Other countries ...	19,000	38,000*	+ 19,000
Total	267,000	252,000	− 15,000
* France, Yen 19,000.			
Gas engines, petroleum engines, and hot-air engines.—			
From Great Britain ...	42,000	6,000	− 36,000
,, Germany	—	3,000	+ 3,000
,, Sweden	85,000	17,000	− 68,000
,, United States ...	35,000	69,000	+ 34,000
,, France	—	84,000	+ 84,000
,, Other countries ...	1,000	1,000	—
Total	163,000	180,000	+ 17,000
Steam engines.—			
From Great Britain ...	51,000	76,000	+ 25,000
,, France	—	81,000	+ 81,000
,, United States ...	3,000	73,000	+ 70,000
,, Other countries ...	—	2,000	+ 2,000
Total	54,000	232,000	+ 178,000
Steam boilers.—			
From Great Britain ...	499,000	1,009,000	+ 510,000
,, Germany	17,000	18,000	+ 1,000
,, United States ...	52,000	192,000	+ 140,000
,, Belgium	2,000	148,000*	+ 146,000
Total	570,000	1,367,000	+ 797,000
* France, Yen 120,000.			
Dynamos, electric motors, &c.—			
From Great Britain ...	316,000	241,000	− 75,000
,, Germany	32,000	18,000	− 14,000
,, Switzerland ...	3,000	62,000	+ 59,000
,, United States ...	390,000	467,000	+ 77,000
,, Sweden	7,000	—	− 7,000
,, Other countries ...	1,000	46,000*	+ 45,000
Total	749,000	834,000	+ 85,000
* France, Yen 44,000.			
Telegraphic and telephonic instruments and parts.—			
From Great Britain ...	29,000	29,000	—
,, United States ...	14,000	27,000	+ 13,000
,, Other countries ...	6,000	4,000	− 2,000
Total	49,000	60,000	+ 11,000
Water turbines and Pelton wheels.—			
From Great Britain ...	24,000	12,000	− 12,000
,, Germany	18,000	—	− 18,000
,, France	15,000	14,000	− 1,000
,, Switzerland ...	10,000	3,000	− 7,000
,, Sweden	30,000	86,000	+ 56,000
,, United States ...	21,000	—	− 21,000
Total	118,000	115,000	− 3,000
Incandescent electric lamps.—			
From Great Britain ...	2,000	5,000	+ 3,000
,, Germany	23,000	—	− 23,000
,, United States ...	6,000	10,000	+ 4,000
,, Other countries ...	11,000	1,000	− 10,000
Total	42,000	16,000	− 26,000
Filaments for incandescent lamps.—			
From Great Britain ...	8,000	88,000	+ 80,000
,, France	8,000	23,000	+ 15,000
,, Sweden	14,000	73,000	+ 59,000
,, United States ...	108,000	436,000	+ 328,000
,, Other countries ...	4,000	—	− 4,000
Total	142,000	620,000	+ 478,000
Wattmeters.—			
From Great Britain ...	8,000	5,000	− 3,000
,, Germany	5,000	4,000	− 1,000
,, United States ...	62,000	55,000	− 7,000
,, Switzerland ...	42,000	67,000	+ 25,000
,, Other countries ...	1,000	1,000	—
Total	118,000	132,000	+ 14,000
Ampere and voltmeters.—			
From Great Britain ...	2,000	2,000	—
,, United States ...	43,000	69,000	+ 26,000
Total	45,000	71,000	+ 26,000
Accumulators.—			
From Great Britain ...	39,000	8,000	− 31,000
,, Germany	—	2,000	+ 2,000
,, Other countries ...	1,000	1,000	—
Total	40,000	11,000	− 29,000
India-rubber and gutta-percha, crude.—			
From British India ...	941,000	1,001,000	+ 60,000
,, Straits Settlements	1,727,000	4,968,000	+ 3,241,000
,, Dutch India ...	226,000	165,000	− 61,000
,, Great Britain ...	394,000	480,000	+ 86,000
,, Germany	1,000	—	− 1,000
,, United States ...	118,000	135,000	+ 17,000
,, Other countries ...	25,000	497,000	+ 472,000
Total	3,432,000	7,246,000	+ 3,814,000

EXPORTS.

	1915. Yen.	1916. Yen.	Inc. or dec. Yen.
Electric machines and parts thereof.—			
To Asiatic Russia ..	22,000	334,000	+ 312,000
,, China	255,000	350,000	+ 95,000
,, Kwantung Province ...	150,000	276,000	+ 126,000
,, Philippine Islands ...	4,000	11,000	+ 7,000
,, Siam	5,000	18,000	+ 13,000
,, Australia	65,000	129,000	+ 64,000
,, Hong-Kong	31,000	41,000	+ 10,000
,, British India	25,000	101,000	+ 76,000
,, Straits Settlements ...	6,000	14,000	+ 8,000
,, Great Britain ...	11,000	104,000	+ 93,000
,, Other countries ...	8,000	69,000	+ 61,000
Total	582,000	1,447,000	+ 865,000
Insulated electric wire.—			
To Siam	5,000	19,000	+ 14,000
,, China	399,000	490,000	+ 91,000
,, Kwantung Province ...	193,000	213,000	+ 20,000
,, Hong-Kong	61,000	19,000	− 42,000
,, British India	9,000	48,000	+ 39,000
,, Dutch India	10,000	5,000	− 5,000
,, Asiatic Russia ...	43,000	166,000	+ 123,000
,, Great Britain ...	160,000	2,000	− 158,000
,, France	13,000	—	− 13,000
,, Australia	4,000	74,000	+ 70,000
,, Other countries ...	3,000	90,000	+ 87,000
Total	900,000	1,126,000	+ 226,000

Yen = 2s. 0¼d.

THE OXIDE FILM LIGHTNING ARRESTER.*

By CROSBY FIELD.

This paper will be confined to a brief statement of the scientific principles underlying a new type of lightning arrester called the "oxide film arrester." The functioning of this arrester depends upon the fact that certain dry chemical compounds can be changed with extreme rapidity from very good conductors of electricity to almost perfect non-conductors by the application of a slight degree of heat. Lead peroxide is a good example of such a substance. It has a specific resistance of the order of one ohm per inch cube, and the resistance varies with the pressure to which it has been compressed. At a temperature of about 150 deg. C. the lead peroxide ($Pb\ O_2$) will be reduced to red lead, commercially known as minimum ($Pb_3\ O_4$). This has a specific resistance of about 24 million ohms per inch cube. At slightly higher temperatures this minimum will be reduced through the sesquioxide ($Pb_2\ O_3$) to litharge ($Pb\ O$), which last named is practically an insulator. There are several other compounds that will give these same results.

If lead peroxide powder be placed between two electrodes and a current passed between them, the temperature due to the resistance at the contact of the peroxide and the metal will cause heat to be generated locally at the surface. When this heat is sufficient to create a temperature of about 150 deg. C. a film of the lower oxides of lead forms, producing a film of insulation which stops the current.

This method of film formation over a large area is irregular. As an insulating film spread on the metal plates there have been used thin layers of various substances; in all cases the results are similar, varying only with the voltage at which puncture of the film of insulation occurs.

The foregoing designs the principle of the commercial oxide film arrester, fig. 1; it comprises two sheet metal electrodes

Fig. 2.

Fig. 1.

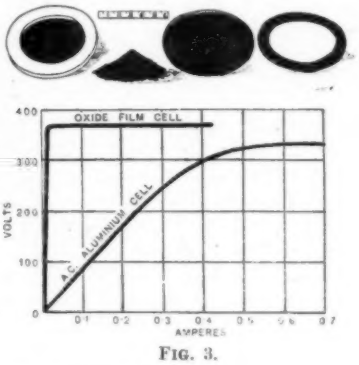


Fig. 3.

Fig. 1.—Single Cell.

Fig. 2.—Disassembled Parts.

Fig. 3.—Comparative Volt-ampere Characteristics of Oxide Film and a.c. Aluminium Arrester Cells.

set about 0.5 in. (12.7 mm.) apart, one or both covered with a thin insulating film and the space between the plates filled with some such substance as lead peroxide. At a permissible voltage of 300 volts per cell the insulating film prevents any appreciable current flowing under normal conditions. As soon as the voltage rises slightly above normal the film punctures in one or more microscopic points, the lightning charge meets with practically no resistance, and flows to earth.

The dynamic current starts to follow, but because the insulation was punctured in such fine points, the current density near these points is exceedingly great. The result is localised heating, which speedily raises the temperature to a value sufficient to change to insulating litharge all the conducting peroxide in this minute path of the current flow in contact with the electrodes. The film consequently reseals, stopping the flow of dynamic current. This action is so rapid that its duration cannot be measured on an oscillograph giving two thousand cycles per second. The action of resealing occurs in less than one four-thousandth part of a second after the excess of lighting voltage has ceased. Fig. 5 shows the visible spots of insulating litharge plugs on the surface of an electrode.

Of the methods of forming the film the most preferable is by dipping in varnish or lacquer highly burnished surfaces of brass, steel or copper, which method is consequently used in the commercial arrester. The ohmic resistance of the arrester during discharge is quite low (less than 1 ohm per cell). Thus when the insulating film is punctured the arrester offers very slight impedance to the flow of energy at abnormal voltages.

There is a certain range of voltage necessary to pierce any given insulation. The exact voltage depends not only upon the thickness of the insulation and its dielectric strength, but also on the relation of the dielectric spark lag to the duration of the super-spark potential and the frequency of alterations of the transient surge.

If an arrester is to give protection of insulation in shunt with it, the arrester must relieve the abnormal electric pressure before damage is done to the insulation. Although tests are frequently made with the arrester and the insulation it is to protect in parallel, a more convenient method has been standardised and is known as the equivalent sphere gap test. Both the insulation and the arrester are compared by comparing each to the equivalent sphere gap.

The equivalent sphere gap of the oxide film arrester may be analysed into separate and distinct parts. First, there is the

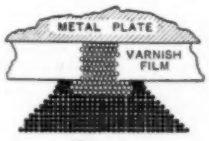


Fig. 4.

Fig. 5.

Fig. 4.—Magnified, Imaginary Representation of one Film on one Metal Plate.

Fig. 5.—New Electrode and one after having passed through it Several Thousand Discharges.

equivalent sphere gap of the main gap in series with the cells. Second, the equivalent sphere gap to initiate a discharge through the insulating film on the plate surface of the cell. Third, there is the equivalent sphere gap of the resistance drop of the current discharging through the powdered peroxide in its path. Fourth, there is the equivalent sphere gap of the inductance of the arrester.

Commenting on these factors in their relation to this arrester, the main gap is itself a sphere gap which has the fastest spark of any practical gap. The gap setting is only slightly above that of the normal voltage of the circuit. The equivalent sphere gap of the film is several times greater than the thickness of the film because solid material has a greater dielectric spark lag than air, but with this multiple of the thickness of the film the equivalent sphere gap is still low. Since peroxide is a good conductor, the series resistance in the path of the discharge is insufficient to give an undesirable voltage drop. As to the inductance of the arrester, it has a minimum value due to the fact that each cell is only 0.5 in. long, as shown in Fig. 1, and these cells are placed one on top of another. In other words, the total length of the arrester (which constitutes the inductance) is short as compared to the necessary length of conductor from line to earth.

One of the obstacles that had to be overcome in the making of this arrester was the increase in the resistance after a great many heavy discharges had passed through it.

In all the commercial oxide film arresters used for alternating current the power factor is nearly unity. For special purposes the power factor can be made anything desired from 10 per cent. to unity. This is obtained by combining with the conducting oxide other non-conducting materials. This principle has been made use of for condensers, but it has not been found desirable to incorporate it in the arrester.

To summarise—an arrester operating under a new principle has been made which comprises in essence one or more metal electrodes covered with an insulating film, and separated by a conducting powder, which has the peculiar characteristic of

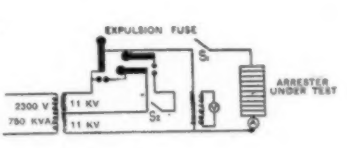


Fig. 6.

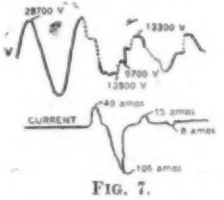


Fig. 7.

Fig. 6.—Test Circuit Arrangement of Oxide Film Arrester.

Fig. 7.—Operation of Arrester on Double Voltage and its Recovery.

becoming a non-conducting powder upon the application of heat. Voltage higher than that which can be withstood by the insulating film punctures it in one or more points of about 0.005 cm. diameter. Dynamic current flowing gives a high current density in the conducting powder adjacent to these punctures which in turn heats it up rapidly, reducing the powder to a non-conductor, and sealing the holes in the film. The powder being a poor heat conductor localises this action, so that very little more powder is reduced than is actually necessary to seal up the minute punctures. The critical spark voltage and that part of the equivalent sphere gap controlled thereby is a function of the thickness and kind of material used for the film.

* *Proceedings*, A.I.E.E., Vol. 37, No. 6. Abstract.

The earliest form of non-electrolytic film arrester was known as the dry aluminium arrester. One of the objects of the development of this arrester was to decrease the cost of manufacture, and it was found with the new principle involved in the oxide film arrester, where the powder furnishes the film rather than the plate, that the aluminium could be replaced by a cheaper metal, such as steel, and the initial film known in the early stages of development as the "paint skin" type could be furnished by a layer of varnish. On first sight, knowing the extreme thinness of the hydroxide film on wet aluminium cell it might not seem that the dry cell would give the same general characteristics as the wet cell; but a comparison of the volt-ampere curves shows the same general characteristics. The oxide film arrester has no dissolution of the film, as occurs in the wet aluminium cell; charging is not only unnecessary but undesirable. This extends the use of the oxide film arrester to localities where there are no attendants.

In the oxide film arrester the film less than one 1 mil thick (0.025 mm.) initially thickens up by the addition of successive spots of litharge for each successive discharge. This represents the wear on the arrester and limits its total life. Fig. 3 shows comparative volt-ampere characteristics of the oxide film arrester and the A.C. aluminium arrester. Since both of these arresters have a leakage current which wears the plates of the cells when alternating current is supplied, it is necessary to place a spark gap in series with the cells. This spark gap is set at a value slightly above the normal potential of the circuit so that nothing but abnormal voltages will cause a discharge.

The oxide film arrester has general characteristics closely like the standard aluminium electrolytic arrester. It has the obvious advantages of being dry rather than wet, and will not congeal, and needs no daily charging.

In making the characteristic volt-ampere discharge curves the oxide film arrester does not lend itself as readily to the test as the wet aluminium cell. While its critical film voltage is evident, the change from no to full conduction is more sudden, and the discharge rate at double potential is therefore best shown by throwing double potential on the cell and subsequently reducing the voltage to its normal value per cell. In order to conveniently alter the voltage from double value to normal the circuit is arranged as shown in fig. 6.

A transformer with two coils in series impresses voltage on the arrester, and then the contacts of the arrester are automatically shifted to one coil giving half the voltage. A heavy pendulum closes switch S-1 and sets the oscillograph in operation. The full voltage on the transformer is then thrown on to the oxide film arrester under test, which has a number of cells sufficient only for half the voltage of the transformer. This throws double voltage on to the arrester and the heavy current passing through the cells causes fuse F-1 to blow. The operation of this fuse short circuits half the transformer and throws the other half across the arrester. This is done by means of gaps and fuses as follows: When the expulsion fuse F-1 blows, the conducting gases are shot into the open gap G-1 which closes the circuit through fuse F-2 to the mid-point of the transformer. This short circuit on half the transformer causes fuse F-2 to blow and the hot gases discharging from fuse F-2 close the gap G-2 which throws the mid-point of the transformer on to the arrester through the switch S-2 which is closed just previous to starting the test. These several operations occur with a rapidity depending upon the size of fuses used. It is possible by this means to throw momentarily 22,000 volts on an 11,000 volt arrester and note the character attending its discharge and recovery. Fig. 7 shows such an operation on an oxide film arrester. The initial discharge current is 40 amperes during the first half-cycle, due to the point it strikes in the descending wave; during the second half-cycle it is 106 amperes. After the third half-cycle the litharge film has so completely sealed up the path of discharge that the current is too small to show on the oscillogram. The leakage current with no series gap is of the order of a few milliamperes.

Increases in Engineering Wages.—The *Times* states that awards have been issued by the Committee on Production giving an advance of wages to men in the engineering, shipbuilding, and allied trades and in the ship repairing trade in the Liverpool district. They follow hearings by the Committee held in pursuance of agreements between the employers' federations and various trade unions providing for a review of wages in the engineering, shipbuilding, and allied trades every four months during the war. "The Committee heard the parties on various dates in in June and July, when applications for increased wages of varying amounts were submitted. By previous awards the men had received advances over pre-war rates of not less than 20s. a week in the case of time-workers and 13s. a week, plus an increase of not less than 10 per cent. on piece prices, in the case of piece-workers. In addition to these advances, earnings have been increased by grants of a bonus of 12½ per cent. in the case of plain-time workers and 7½ per cent. in the case of piece-workers and other workmen who are not paid at plain-time rates. The present award is that men aged 18 and over are to receive a further advance of 3s. 6d. a week, and boys and youths and apprentices under 18, 1s. 9d. a week. These advances are to be paid on the first pay day in the week ending August 10th, 1918."

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

11,562. "Energy-regulating arrangements for electric circuits." Siemens Schuckertwerke. July 15th. (Germany, June 13th, 1917.)

11,573. "Electric locomotives or cars." British Thomson-Houston Co. (General Electric Co., U.S.A.) July 15th.

11,577. "Magnetic tray control for use in biscuit-making machinery." A. E. Bowers & A. Mason. July 15th.

11,582. "Windings for dynamo-electric machines." British Westinghouse Electric & Manufacturing Co. July 15th.

11,583. "Electric fuse cabinets." W. T. Tallent-Bateman & British Westinghouse Electric & Manufacturing Co. July 15th.

11,587. "Telephone receivers." H. E. Parry. July 15th.

11,595. "Electrical testing devices." R. C. Bierbower. July 15th.

11,598. "Sparking plugs." C. H. Hanwell & O. E. Hanwell. July 15th.

11,613. "Electric lampholders, &c." Wardle Engineering Co. & H. T. Wilkinson. July 16th.

11,616. "Apparatus for teaching telegraph codes." C. R. Woodland and R. Woodland. July 16th.

11,619. "Sparking plugs for internal-combustion engines." W. A. Clark, H. G. Longford, W. W. Longford & Sphinx Manufacturing Co. July 16th.

11,625. "Electric soldering irons." J. G. Clemens. July 16th.

11,628. "Electric cord protector." C. R. Dodge. July 16th.

11,635. "Dry-battery terminals." R. Wilson. July 16th.

11,651. "Bobbins for electrical purposes." A. J. Chevallay. July 16th.

11,657. "Electric circuit-controlling devices." E. C. R. Marks (Splitdorf Electrical Co.). July 16th.

11,664. "Leaf springs for use in breakers, &c." Soc. Anon. des Etablissements L. Blériot. July 16th. (France, April 12th.)

11,709/10. "Telephone repeater systems." R. M. Chamney & C. Robinson. July 17th.

11,725. "Current regulators or transformers of the constant-current type." W. Langdon-Davies & A. Soames. July 17th.

11,739. "Electrolytic cells." E. C. R. Marks (A. T. Stuart). July 17th.

11,751. "Self-starting devices for internal-combustion engines." F. L. Rapson. July 17th.

11,779. "Trolley heads for electric traction." F. Haigh, W. Pickersgill and J. H. Vitt. July 18th.

11,804. "Directional aerials for wireless telegraphy." G. M. Wright. July 18th.

11,856. "Means for measuring electrical currents." H. A. Ewen. July 19th.

11,857. "Automatic or semi-automatic telephone systems." A. E. Laidlaw. July 19th.

11,858. "Electric incandescent lamps." G. Layton. July 19th.

11,868. "Ignition sparking plugs for internal-combustion engines." F. L. Rapson. July 19th.

11,903. "Induction electric motor with variable numbers of poles." Akt. Ges. Brown, Boveri et Cie. July 20th. (Germany, July 21st, 1917.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

4,629. Means for securing shades to the holders of electric lamps. H. F. Wheeler. March 30th, 1917. (116,906.)

5,804. Apparatus for detecting and magnifying minute electric impulses. P. Harvey. April 25th, 1917. (116,908.)

8,934. Dynamo-electric machines. British Thomson-Houston Co. & A. A. Pollock. June 21st, 1917. (116,915.)

9,035. Signalling and train-stopping apparatus. E. H. Whitehead. June 23rd, 1917. (116,918.)

9,239. Electrical boat-raising and lowering apparatus. A. West & Co., A. West & F. N. Pickett. June 27th, 1917. (116,925.)

9,320. Diaphragm horns. Klaxon Co., J. F. Monnot & E. T. Cook. June 28th, 1917. (116,930.)

9,488. Control of combined engines and electric generators. W. A. Stevens and J. Sankey & Sons. June 30th, 1917. (116,941.)

16,372. Thermal ammeters. Weston Electrical Instrument Co. July 27th, 1916. (109,046.)

10,612. Temporary electric connecting clip. S. George & T. J. Hutchison. July 24th, 1917. (116,956.)

11,497. Apparatus for electrically distilling ores and metal-bearing materials. D. B. Jones. December 7th, 1916. (111,835.)

12,924. Luminous electric-light switch. C. D. S. Cranko. September 10th, 1917. (116,978.)

13,166. Automatic electric switching apparatus. M. S. Conner & C. C. Puckette. September 14th, 1917. (116,981.)

14,097. Sparking plugs. M. J. Willcocks. September 29th, 1917. (Cognate application 17,876/17.) (116,992.)

14,992. Troughs for electric cables and the like. F. E. Worsdell and Callender's Cable & Construction Co. October 16th, 1917. (117,001.)

16,932. Electrically-operated overhead lifting gear. W. H. Vaughan and F. Wood. November 17th, 1917. (117,019.)

17,511. Production of alternating current for signalling in telephonic and other systems. Western Electric Co. (Western Electric Co., U.S.A.) November 27th, 1917. (117,020.)

18,449. Machines for applying caps to electrode rods of batteries. S. L. Casella. January 2nd, 1917. (112,933.)

1918.

363. Measurement and correction of any want of equilibrium in the moving systems of electrical instruments. J. Rymer-Jones. January 7th, 1918. (117,038.)

1,124. Driving gear for electric locomotives. Akt. Ges. Brown, Boveri et Cie. March 29th, 1917. (Addition to 112,009.) (114,417.)